Techneau,
November 2006

TREND REPORT

REPORT ON TRENDS IN
South Africa / Sub-Sahara Africa

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Executive Summary

Information is supplied on current trends and facts in drinking water supply (source to tap) for Southern and sub-Saharan Africa. These trends and facts are provided in the appendix to the report (questionnaire). From the trends, the ten most important ones impacting on drinking water supply in the regions under consideration were identified and are discussed in Chapter 3 of the report.

The main source for identifying and prioritising the trends was the results of a workshop that was held in Windhoek (Namibia) during March 2006 on *Science and Technology-based Scenarios for sub-Saharan Africa* and at which Chris Swartz and Drs Rivka Kfir and Gerhard Offringa of the Water Research Commission were, amongst other, participants.

Top Ten Trends for sub-Sahara Africa

The ten main trends in drinking water supply in South Africa and sub-Saharan Africa that were identified, are listed below:

1. Population Growth
2. Urbanisation
3. Degradation of Source Water Quality
4. Climate Change: Water Resource Quantity (Water Stress)
5. Life-style Choices: Point-of-use Systems and Bottled Water
6. Increasing Cost of Energy
7. Better Access to Communication Technology and Information
8. Increase in Water-borne Diseases
9. Degradation of Infrastructure
10. Political Tensions over Water

The main conclusions from the questionnaires and strategic sessions on future drinking water supply in sub-Sahara Africa is summarised below.

Social
There will be an increased drive to supply remaining people without water, including an increased drive to provide remaining Free Basic Water (no charge to consumers) . In general there will be a greater accent on affordability, where the people and their needs will become more important.

Economical
Sub-Sahara africa remains very poor and there will be greater pressure to produce and supply more affordable water. The high population growth and urbanisation trend will put increased pressure on improved water demand management – also on household level. Greater emphasis will be on low running cost technology (people pay the running costs), and integrated with this will be pressure to produce and utilize renewable energy sources at a lower cost.

Political
More political pressure will be exerted to develop and exploit alternative water and energy sources. The impact of global warming will be substantial, leading to water shortages in certain areas and flooding in other areas.

The quality of the drinking water for the immune deficient and vulnerable will become important.

The skills shortage on the sub-continent will continue.

Technological
The major challenge related to the provision of drinking water is the current prevalence of intermittent supply systems, incompatible with any reasonable drinking warer quality requirements at the consumer tap.

Membranes are becoming increasingly important in light of increased pollution, and renewable energy technologies will be required. Improved and economical water harvesting methods will also be required.

There will be higher demands on treatment plants for removal of increased levels and variety of chemicals and microbiological contaminants (including the increasing NOM levels in surface waters). Consequently, newer bio-technologies will play an increasing role in the water sector.

Nanotechnology will take off on large scale and this will present enormous opportunities in the water field. High development costs will further force adaptation of international technologies to South African conditions.

Continued skills shortage will increase automation and telemetric-control of plants.

Environmental
Droughts are becoming more of a problem as water resources become overused and global warming starts to have an effect. Pollution of water resources will become worse as resources become overused. Anthropogenic chemicals in the environment will become more of an issue (EDC's, drugs, beauty care products, industrial chemicals). Management of water-related wastes will become a bigger issue.

The most important trends that will affect Southern and sub-Sahara Africa are:

- high population growth and large-scale urbanisation
- deterioration of source water quality
- climate change and its effect on sustainable water supply
- the cost and availability of energy

CD Swartz
G Offringa
November 2006

TKI Categorisation

Classification									
Supply Chain		**Process Chain**		**Process Chain (cont'd)**		**Water Quality**		**Water Quantity (cont'd)**	
Source	X	**Raw water storage**		**Sludge treatment**		**Legislation/regulation**		- Leakage	
- Catchment		- Supply reservoir		- Settlement		- Raw water (source)		- Recycle	
- Groundwater		- Bankside storage		- Thickening		- Treated water			
- Surface water		**Pretreatment**		- Dewatering		**Chemical**			
- Spring water		- Screening		- Disposal		- Organic compounds			
- Storm water		- Microstraining		**Chemical dosing**		- Inorganic compounds			
- Brackish/seawater		**Primary treatment**		- pH adjustment		- Disinfection by-products			
- Wastewater		- Sedimentation		- Coagulant		- Corrosion			
Raw water storage	X	- Rapid filtration		- Polyelectrolyte		- Scaling			
- Supply reservoir		- Slow sand filtration		- Disinfectant		- Chlorine decay			
- Bankside storage		- Bank filtration		- Lead/plumbosolvency		**Microbiological**			
Water treatment	X	- Dune infiltration		**Control/instrumentation**		- Viruses		**Consumers / Risk**	
- Pretreatment		**Secondary treatment**		- Flow		- Parasites			
- Primary treatment		- Coagulation/flocculation		- Pressure		- Bacteria		**Trust**	X
- Secondary treatment		- Sedimentation		- pH		- Fungi		- In water safety/quality	
- Sludge treatment		- Filtration		- Chlorine		**Aesthetic**		- In security of supply	
Treated water storage	X	- Dissolved air flotation(DAF)		- Dosing		- Hardness / alkalinity		- In suppliers	
- Service reservoir		- Ion exchange		- Telemetry		- pH		- In regulations and regulators	
Distribution	X	- Membrane treatment		**Analysis**		- Turbidity		**Willingness-to-pay/acceptance**	
- Pumps		- Adsorption		- Chemical		- Colour		- For safety	
- Supply pipe / main		- Disinfection		- Microbiological		- Taste		- For improved taste/odour	
Tap (Customer)		- Dechlorination		- Physical		- Odour		- For infrastructure	
- Supply (service) pipe		**Treated water storage**						- For security of supply	

- Internal plumbing		- Service reservoir				**Water Quantity**		**Risk Communication**	
- Internal storage		**Distribution**						- Communication strategies	
		- Disinfection				**Source**	X	- Potential pitfalls	
		- Lead/plumbosolvency				- Source management		- Proven techniques	
		- Manganese control				- Alternative source(s)			
		- Biofilm control				**Management**	X		
		Tap (Customer)				- Water balance			
		- Point-of-entry (POE)				- Demand/supply trend(s)			
		- Point-of-use (POU)				- Demand reduction			

TKI Categorisation (continued)

Contains		**Constraints**		**Meta data**					
Report	X	Low cost		*Author(s)*		CD Swartz		G Offringa	
Database		Simple technology		*Organisation(s)*		Chris Swartz Engineers		WRC	
Spreadsheet		No/low skill requirement		*Contact name*					
Model		No/low energy requirement		*Contact email*					
Research		No/low chemical requirement		*Quality controller name*		**Helena Alegre**			
Literature review		No/low sludge production		*Quality controlerl organisation*		LNEC			
Trend analysis	X	Rural location		Source					
Case study / demonstration		Developing world location	X	*Date prepared*					
Financial / organisational				Date submitted (TKI)		November 2006			
Methodology				Date revised (TKI)		March 2007			
Legislation / regulation									
Benchmarking									

Contents

1 General Description

Information is supplied on current trends and facts in water supply (source to tap) for Southern and sub-Saharan Africa. These trends and facts are provided in the appendix to the report (questionnaire). From the trends, the ten most important ones impacting on drinking water supply in the regions under consideration were identified and are discussed in Chapter 3 of the report.

The main source for identifying and prioritising the trends was the results of a workshop that was held in Windhoek (Namibia) during March 2006 on *Science and Technology-based Scenarios for sub-Saharan Africa* and at which Chris Swartz and Drs Rivka Kfir and Gerhard Offringa of the Water Research Commission were, amongst other, participants.

Background to the workshop

The United Nations World Water Development Report No 2 of March 2006 states that environmental degradation, poor management and a burgeoning population have produced some of the worst water shortages in the world in sub-Saharan Africa, exacerbating poverty and disease. The associated challenge is illustrated by the fact that the population of sub-Saharan Africa, despite the impact of HIV/AIDS, is projected to grow to 1.1 billion in 2050 from 532 million in 1995.

The GRA, in association with various international agencies and stakeholders, has embarked on a journey to generate baseline stories for creating plausible science and technology-based water scenarios which can illuminate worthy actions. With this in mind a workshop was held from 26 – 29 March 2006 in Windhoek, Namibia, at which more than 30 water scientists from 15 countries made inputs to identify the underlying drivers and outcomes and produce the baseline storylines for the scenarios, and which was printed towards the middle of the year. Chris Swartz, Dr Gerhard Offringa and Dr Rivka Kfir were among the participants at the workshop.

The workshop was made possible through the generous support of the World Association of Industrial and Technological Research Organizations (WAITRO) with its Secretariat in Kuala Lumpur, the British High Commission in Namibia, the German Federal Ministry for Education and Research, the Fraunhofer-Gesellschaft in Germany, the Finnish Embassy in Pretoria and the South African Water Research Commission.

Top Ten Trends for sub-Sahara Africa

The ten main trends in drinking water supply in Southern and sub-Saharan Africa that were identified are listed below:

1. Population Growth
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More information on these trends is given in Chapter 3 of the report, under the headings:

- Introduction
- Definitions
- Driving Forces
- General Implications
- Implications for the Water Industry
- Adaptive Strategies
- Conclusion

2 Summary of the questionnaire

The questionnaire used in obtaining data was based on the **SEPTEDOR** dimensional analysis, *i.e.*

S Socio-cultural factors
- Willingness to pay
- Whether consumers are informed
- Appreciation of water
- Ecological awareness
- Land reform issues
- Gender mainstreaming
- Marginalised communities

E Economical factors
- Financing models
- Maintenance/renovation of infrastructure
- Energy costs and energy consumption
- Role of decentralised systems

P Political factors
- Decision making process of innovations/investments
- Role of NGO's
- Administrative procedures
- Role of political parties

T Technical factors
- Breakthrough technologies
- Emerging technologies
- Point-of-use systems
- Water recycling systems
- Water saving technologies

E Ecological factors
- Emerging pollutants
- Accumulation of pollutants
- Pollution control
- Water resources

D Demographical factors
- Population distribution (Urban vs. rural)
- Population growth
- Life expectancy
- Educational level

O Organisational factors
- Privatisation
- Centralisation / regionalisation

R Risk-related factors
- Terror attacks
- Technical failure
- Water quality
- Water availability

Summary of some facts and figures for sub-Sahara Africa(as background)

- Water scarcity is fundamentally a problem of the distributions of climate and human society, which vary greatly around the world. Compared to the global proportion of 52% of total population living in arid or semi-arid regions, approximately 75% of all Africans live in such conditions. In addition, 20% of all Africans live in areas that experience high inter-annual climatic variability. This explains why Africa suffers disproportionately from water scarcity and water stress compared to other continents.
- The disparities in water resources are blatant. For example, available per capita water resources in Peru are more than 60,000 m^3/y, but only 1,000 m^3/y in South Africa. Yet the incidence of poverty in Peru is greater than in South Africa, which means that a large amount of available water resources is not sufficient in and of itself to combat poverty; good management of these resources is also necessary.
- It is estimated that daily water use per inhabitant totals 600L in residential areas of North America and Japan and between 250L and 350L in Europe, while daily water use per inhabitant in sub-Saharan Africa averages just 10L to 20L.
- In sub-Saharan Africa, only 25% of the population has access to electricity, while 83% of the urban population and 46% of the rural population have access to a water supply.
- Drinking-water coverage in sub-Saharan Africa increased from 49% to 58% between 1990 and 2002. Yet this falls short of the progress needed to achieve the MDG target of 75% coverage by 2015.
- The fraction of urban population in Africa has nearly tripled in the last 50 years. By 2020, Africa's urban population is estimated to reach 500 million – up from 138 million in 1990. Malawi is the current fastest urbanizing nation due to population flight from severe flooding.
- Research on the changing urban water systems in Africa, where insufficient infrastructure is a major problem, indicates that while in the early 1970s many major cities still used groundwater supplies as their primary water source, by the 1990s primary sources were more likely to be rivers, and increasingly these river sources were more than 25 kilometres away.
- Throughout Africa, seasonal climate variation and unpredictable water depths limit the number of inland water bodies that are navigable. There are only three rivers classified as international waterways in Africa: the Congo, Nile and Zambezi rivers. Hydraulic work could, however, increase the number of potentially navigable rivers on the continent.
- The Congo-Zaire basin carries 33% of the river flow in Africa
- In sub-Saharan Africa, 84% of total water diversions is used in agriculture.
- Individual freshwater systems can be extremely important in supporting high numbers of endemic species. According to the

Ramsar Convention on Wetlands, Lake Tanganyika in Central Africa, for example, supports 632 endemic animal species.

(Facts and figures above taken from the 2nd United Nations World Water Development Report (WWDR), 'Water, a shared responsibility' **(http://www.unesco.org/water/wwap/wwdr2/))**

3 Top 10 trends

3.1 Population Growth

3.1.1 Introduction

Type of factor: Demographic.
Population growth in sub-Sahara Africa has historically always been high, and is expected to continue to be high, even with high prevalence of HIV/AIDS in this region.

3.1.2 Definitions

Population in sub-Sahara Africa is estimated to increase from 432 million in 1995 to 910 million in 2025.

3.1.3 Driving Forces

The extent of population growth will be determined by the economies of the respective countries in sub-Saharan Africa, and the region as a whole (i.e poverty levels); the effect of water-borne diseases on mortality rates (especially amongst infants); the impact of HIV/AIDS on certain countries (especially in the south); health programmes.

3.1.4 General Implications

The high population growth in the area will place enormous pressure on the existing water sources, especially in those countries already experiencing water stress. There will also be a greater demand on food from available sources.

3.1.5 Implications for the water industry

As a result of the substantial increase in water demand, alternative water resources will have to be exploited, such as groundwater exploitation, water reclamation and reuse, rainwater harvesting, desalination of seawater and brackish water. It is expected that central government will need to start intervening on a large scale to assist local authorities and communities to supply water for drinking purposes.

There will be increasing tensions regarding the allocation of water, from community level through to international level where water resources are shared (which is the case in the majority of countries in sub-Saharan Africa).

The high population increase will also result in sanitation backlogs and pollution of water sources, requiring in many cases additional water

treatment technologies to produce water complying with health requirements (WHO). The international community is expected to play a major role in supplying these technologies, of which Europe and China will play a major role. Innovative systems will be required.

The trend will be more towards centralised water treatment rather than decentralised treatment in the rural and peri-urban areas. In the more affluent societies in the cities there will be increasing use of household water treatment systems (point-of-use and point-of-entry) and there will be very active competition in the marketing and supply of these systems.

3.1.6 Adaptive Strategies

Effective water demand management will be critical. Better regional cooperation will be necessary (political cooperation between countries sharing water sources). Innovative solutions for exploitation of alternative water resources and treatment technologies (to enhance existing systems) will be required.

3.1.7 Conclusion

The high population growth in sub-Sahara Africa will place enormous pressure on the existing water sources, especially in those countries already experiencing water stress. There will also be a greater demand on food from available sources, for which more water is required. The high population increase will also result in sanitation backlogs and pollution of water sources.

Additional water treatment technologies to produce water complying with health requirements, and alternative water resources will have to be exploited, such as groundwater exploitation, water reclamation and reuse, rainwater harvesting, desalination of seawater and brackish water.

The international community will play a major role in supplying these technologies, of which Europe and China is expected to play leading roles. Innovative systems will be required.

The trend in sub-Sahara Africa will be more towards centralised water treatment rather than decentralised treatment in the rural and peri-urban areas.

3.2 Urbanisation

3.2.1 Introduction

Type of factor: Demographic.
Urbanisation in South Africa (and other African countries) has been steadily increasing during the last two decades, but has been increasing dramatically during the past five years or so. It is expected to increase even more rapidly in the immediate future (at least for the time window of this study), but in the

long term there may be some return to rural areas as the stresses of over-population in urban areas takes its toll.

3.2.2 Definitions

A major migration from rural areas where unemployment is extremely high and resources are few, to the large cities in an attempt to find jobs and have more access to amenities. Examples (in South Africa) are Cape Town metropole, Durban, Johannesburg.

3.2.3 Driving Forces

Economic prosperity will dictate poverty and unemployment levels, which in its turn will determine to what levels urbanisation in African countries, and in South Africa in particular, will increase or stabilise.

3.2.4 General Implications

The current trend results in major challenges for planners and authorities to provide satisfactory urban water supply and sanitation facilities that can meet all the needs. It will have a major effect on pollution levels and on crime.

3.2.5 Implications for the water industry

There will be a strain on existing infrastructure, and requirements for new services and infrastructure will be more than what can be supplied. With concomitant degradation of existing infrastructure, it will place huge burdens on the local authorities (financial and capacity) to meet the requirements. International funding will undoubtedly be necessary to try to alleviate the backlogs.

Extensions to large water treatment plants and distribution systems will be required, and in many cases more advanced technologies (*e.g.*membranes and advanced oxidation) will also be required to treat the poorer raw water quality, new contaminants and micropollutants. However, bear in mind that the bottleneck is almost always in the distribution system.

More emphasis will be placed on urban water supply in research and development programmes (*cf.* GWRC initiatives). Research on how to improve urban water demand management will receive high priority.

3.2.6 Adaptive Strategies

Use of alternative water resources, such as water reclamation and reuse; seawater desalination in coastal cities; reducing water losses by better water demand management; upliftment programmes and development in rural areas in an attempt to counter the urbanisation trend. Meet the MDG's in rural areas.

3.2.7 Conclusion

A major migration from rural areas where unemployment is extremely high and resources are few, to the large cities in an attempt to find jobs and have more access to amenities is taking place in sub-Sahara Africa, and will continue to do so.

There will be a strain on existing infrastructure, and international funding will be necessary to try to alleviate the backlogs. More advanced technologies (*e.g.* membranes and advanced oxidation) will also be required to treat the poorer raw water quality. There will be more emphasis on urban water supply in research and development programmes in Africa.

3.3 Degradation of Source Water Quality

3.3.1 Introduction

Type of factor: Ecological; Technological.
Increasing pollution and wider dispersal of pollutants is taking place. The trend is expected to continue in African countries, and in South Africa in particular where there is large scale migration from the north to SA.

3.3.2 Definitions

This trend comprises the increasing decline in water quality of raw water sources in African and developing countries. It is mostly contamination of surface water sources as a result of poor sanitation, wastewater treatment plants not function satisfactorily, and discharge. Groundwater sources are also contaminated by improper sanitation facilities. Examples are the Vaal River in South Africa and Lake Victoria.

3.3.3 Driving Forces

Increasing population; urbanisation; industrialisation; change in life-style resulting in higher waste loads. The trend is expected to continue and even increase in the urban areas.

3.3.4 General Implications

The poorer source water quality will lead to increasingly difficulties to produce drinking water that complies with basic health standards, resulting in potentially more incidences of outbreak of water-borne diseases. More emerging pollutants will land in raw water sources, requiring new strategies to manage this situation.

3.3.5 Implications for the water industry

Improved technologies will be required to treat the poorer raw water quality, as the conventional treatment systems of coagulation/flocculation, sedimentation, filtration and chlorination will in many cases not be adequate to ensure safe water. The occurrence of emerging contaminants and increase in water-borne diseases such as malaria, cholera and typhoid (and also diseases that had previously been eradicated or suppressed such as smallpox, dengue fever, Ebola fever and tuberculosis that are likely to re-emerge) will require more advanced treatment technologies, such as membrane treatment and advanced oxidation (UV; ozonation).

The poorer quality drinking water supplied to households in the cities (not only from inadequate treatment but also from quality deterioration in the distribution systems) will lead to more consumers in the affluent societies using point-of-use treatment systems, which will be marketed on large scale in these areas. This will be especially the case in the highly populated areas such as Johannesburg/Pretoria and Cape Town in South Africa.

The gradual increase in organic content (NOM) of surface waters will lead to expedited research in treatment technologies that can reduce these compounds cost-effectively, and that will be sustainable over the long term.

To improve the sustainability of existing treatment systems to treat the poorer raw water quality will need interventions to improve the operation and maintenance of these systems. Some privatisation in this market sector is expected to realise.

3.3.6 Adaptive Strategies

Better source protection; major effort to reach MDG's, thereby improving sanitation services and reducing pollution of water resources; development of cost-effective sustainable treatment systems and technologies applicable to Africa conditions and that of developing countries. Major programmes to improve operation and maintenance of both new and existing technologies. Assessment of steps and processes needed to improve measurement processes, monitoring, database development and data analysis.

3.3.7 Conclusion

There is an increasing decline in water quality of raw water sources in African and developing countries. It will lead to increasingly difficulties to produce drinking water that complies with basic health standards, resulting in potentially more incidences of outbreak of water-borne diseases.

The poorer quality drinking water supplied to households in the cities will lead to more consumers in the affluent societies using point-of-use treatment systems, which will be marketed on large scale in these areas. This will be especially the case in the highly populated areas such as Johannesburg/Pretoria and Cape Town in South Africa.

The gradual increase in organic content (NOM) of surface waters will lead to expedited research in treatment technologies that can reduce these compounds cost-effectively, and that will be sustainable over the long term.

3.4 Climate Change: Water Resource Quantity (Water Stress)

3.4.1 Introduction

Type of factor: Ecological.
Increasing incidence of extreme weather conditions, evident in South Africa where major floods were experienced recently after spells of severe droughts in certain areas (in some instances in the same regions, *e.g.* the Western Cape province in South Africa. There is general consensus that the impact of global climate change will continue for the foreseeable future (at least until 2050), and that it will have definite impact on sub-Sahara Africa.

3.4.2 Definitions

Due to global warming, weather patterns and meteorological systems are resulting in rainfall becoming increasingly unpredictable and leading to major catastrophes. Examples in South Africa are droughts in the western parts of the country, and unprecedented flooding in the Southern and Eastern Cape provinces during August and September of this year. Also changes in vegetation and land-use.

3.4.3 Driving Forces

Global warming as a result of CO_2 emissions. The problem is being addressed in programmes across the globe, but the effects of eradication will take at least fifty years to become evident.

3.4.4 General Implications

The climate change will have a great impact on the availability of water, resulting in water stress and unsustainable development in many regions in Africa, especially in the south-western parts. Flooding results in damage to infrastructure and long lag periods to repair the damage and restore the water supply service to its original condition. Also results in change of water quality in water sources (*e.g.*salinisation).

3.4.5 Implications for the water industry

For drought periods, strict water demand management measures will be required (allocation of water; water restrictions). Water restrictions have already been implemented in a number of towns in the western parts of South Africa. There will also be an increased focus on alternative water supply options and technologies, such as seawater desalination (Cape Town metropole; Swakopmund planning for this; also areas in the southern parts of

the continent). Also increasing R&D of rainwater harvesting and water reclamation and reuse as alternative water supply options.

There has been a significant increase in marketing of desalination technologies in the sub-continent, notably in South Africa. New competitors are entering the market.

Institutionally, the central government will work towards implementing improved water demand managements programmes, particularly in the urban areas.

Increasing migration – particularly to southern Africa and South Africa – is placing further stress on this region's scarce water supplies.

3.4.6 Adaptive Strategies

More emphasis will be required on the use of alternative water sources such as desalination, water reclamation and reuse, rainwater harvesting. Also flood protection to protect water treatment plants against possible damage during flooding, thereby ensuring uninterrupted water supply and acceptable drinking water quality.

3.4.7 Conclusion

There is an increasing incidence of extreme weather conditions in Southern Africa where major floods were experienced recently after spells of severe droughts in certain areas (in some instances in the same regions, *e.g.* the Western Cape province in South Africa). There is general consensus that the impact of global climate change will continue for the foreseeable future (at least until 2050), and that it will have definite impact on sub-Sahara Africa.

There has been a significant increase in marketing of desalination technologies in the sub-continent, notably in South Africa. New competitors are entering the market.

3.5 Life-style Choices (Point-of-use Systems and Bottled Water)

3.5.1 Introduction

Type of factor: Socio-cultural.
The use of point-of-use water treatment devices and bottled water only started to be on any significant scale during the past five years in South Africa, but since then it has grown dramatically, especially bottled water. The trend is expected to continue in urban areas; in rural areas and developing countries the use of POU systems and bottled water will not generally be affordable.

3.5.2 Definitions

The trend comprises the use of household water treatment devices to further improve the quality of piped water supply, mainly due to remove chlorine taste and other taste and odours. Bottled water is consumed rather than tap water due to a number of reasons.

3.5.3 Driving Forces

Deteriorating quality of piped water at the point of use, due to inadequate treatment (which may be the result of poor raw water quality, or poor O&M), and/or water quality deterioration in the distribution system. Another driving force is lack of confidence in drinking water supplied by the water service provider, often the result of marketing efforts of device suppliers, or negative media reports. It many cases it is have become fashionable to drink bottled water.

3.5.4 General Implications

The trend signifies a greater demand for better quality drinking water, which will require the water suppliers to improve their service delivery and quality of the end product if they want to retain consumer confidence.

3.5.5 Implications for the water industry

A wide variety of point-of-use water treatment devices have appeared on the market in South Africa (and some other African countries), and there are very strong marketing drives. Often misleading statements are made regarding the quality of tap water, or what the treatment device can achieve. This has generally resulted in decline in consumer confidence in many areas in South Africa.

More effective communication with consumers will be required to restore the confidence in water supply authorities; however, the water suppliers will need to ensure that water of high quality is not only produced at the treatment plant, but actually delivered at the tap at households (*i.e.* much more focus should be placed on eradicating the deterioration of water quality that takes place in the distribution systems).

3.5.6 Adaptive Strategies

Improve communication with consumers. Improve quality control through effective operation and monitoring, especially in the rural areas where this is generally lacking.

3.5.7 Conclusion

The use of point-of-use water treatment devices and bottled water is expected to continue in urban areas; but in rural areas and developing countries the

use of POU systems and bottled water will not generally be affordable. A wide variety of point-of-use water treatment devices have appeared on the market in South Africa (and some other African countries), and there are very strong marketing drives. , the water suppliers will need to ensure that water of high quality is not only produced at the treatment plant, but actually delivered at the tap at households (*i.e.* much more focus should be placed on eradicating the deterioration of water quality that takes place in the distribution systems).

3.6 Increasing Cost of Energy

3.6.1 Introduction

Type of factor: Economical.
The cost of energy has been increasing only gradually, but is expected to increase much more significantly in future. Energy costs have been relatively low in South Africa compared to other countries.

3.6.2 Definitions

The increasing cost of energy which impacts on the treatment and conveyance of drinking water.

3.6.3 Driving Forces

The cost of energy is driven by the availability and cost of producing the energy; the demand (expected to increase significantly in urban areas in South Africa); and on political cooperation between countries sharing hydro-electric power sources.

3.6.4 General Implications

To make water treatment technologies affordable and sustainable in the developing countries, the energy costs should be minimised, or technologies with lower energy requirements should be developed and/or alternative renewable energy sources should be sought and developed (*e.g.* solar; wind; tidal).

3.6.5 Implications for the water industry

Emphasis will need to be placed on energy efficient water treatment technologies, or on development of alternative energy technologies which will ensure affordable and sustainable treatment systems for developing countries with limited sources.

Research on renewable energy sources will therefore have to be fast-tracked.

For rural and remote areas, research on treatment systems that requires no electricity will be a high priority. The proposed application of membrane technologies in rural areas will need to strive towards using low or no energy, such as gravity fed systems (low-pressure systems).

3.6.6 Adaptive Strategies

Develop water treatment technologies that are energy efficient.
Develop renewable energy resources that could be used in combination with small-scale water treatment technologies for rural and remote areas (decentralisation).

3.6.7 Conclusion

The cost of energy has been increasing only gradually, but is expected to increase much more significantly in future. Energy costs have been relatively low in South Africa compared to other countries. Emphasis will need to be placed on energy efficient water treatment technologies, or on development of alternative energy technologies which will ensure affordable and sustainable treatment systems for developing countries with limited sources.

3.7 Better Access to Communication Technology and Information

3.7.1 Introduction

Type of factor: Technological.
IT technology has impacted on all technological spheres, including water treatment. It has ensured improved process control and remote monitoring.

3.7.2 Definitions

Improvement in communication and information technologies is resulting in improved process and quality control.

3.7.3 Driving Forces

Affordability of improved communication technologies is a main driving force. Access to internet in rural areas and developing countries will ensure more appropriate technologies and better monitoring and control systems.

3.7.4 General Implications

In African countries, the access to information through better communication and IT facilities will result in empowerment of the population, access to knowledge, training and skills development, communication of science results, development of on-line systems, use of satellite data, GIS, and remote sensing and control.

3.7.5 Implications for the water industry

More sophisticated treatment technologies and accompanying control systems will be within reach of the rural and remote communities (as evidenced by the widespread use of cellular telephones world-wide).

3.7.6 Adaptive Strategies

It will be possible to supply treatment technologies to rural and remote areas in Africa that can be controlled remotely via telemetry and communication technology, which should ensure improved sustainability of these systems through rapid corrective action during plant upsets.

3.7.7 Conclusion

More sophisticated treatment technologies and accompanying control systems will be within reach of the rural and remote communities (as evidenced by the widespread use of cellular telephones world-wide). It will be possible to supply treatment technologies to rural and remote areas in sub-Sahara Africa that can be controlled remotely via telemetry and communication technology, which should ensure improved sustainability of these systems through rapid corrective action during plant upsets.

3.8 Increase in Water-borne Diseases

3.8.1 Introduction

Type of factor: Socio-cultural; ecological; demographical.

3.8.2 Definitions

Due to deterioration of service delivery and infrastructure, poor sanitation conditions and pollution of water sources, there is an increase in the number of incidences of water-borne diseases.

3.8.3 Driving Forces

The provision of water supply and sanitation services (meeting the MDG's). Pollution of water sources (ability to prevent pollution and/or source protection).

3.8.4 General Implications

Poorer quality of life (generally) due to illness and deaths associated with/caused by the water-borne diseases is a result of deterioration of quality of water sources. It furthermore leads to increased mortality, especially amongst infants.

3.8.5 Implications for the water industry

There is a need for technologies that can effectively prevent any pathogens, viruses, parasites, emerging micropollutants from occurring in the treated water consumed by communities.

Re-contamination in the distribution network should be prevented by implementing effective monitoring systems.

General health improvement drive needed by governments to ensure adequate sanitation provision and water supply.

3.8.6 Adaptive Strategies

There should be increased environmental awareness.
Water source protection should be high priority.
Development/application of technologies that can prevent pathogens, parasites, etc. occurring in the treated water, *i.e.* the use of barrier treatment systems such as membranes.

3.8.7 Conclusion

In sub-Sahara Africa, there is an increase in poorer quality of life (generally) due to illness and deaths associated with/caused by the water-borne diseases. This includes increased mortality, especially amongst infants. There is a need for the development and application of technologies that can prevent pathogens, parasites, etc. occurring in the treated water, *e.g.* the use of barrier treatment systems such as membranes.

3.9 Degradation of Infrastructure

3.9.1 Introduction

Type of factor: Technological.
This has been an increasing trend in Africa, and is expected to continue in future.

3.9.2 Definitions

Poor condition of all systems in the water supply chain is found, *i.e.in* raw water abstraction, treatment facilities, storage facilities, distribution network.

3.9.3 Driving Forces

Poor maintenance, caused by political issues, mismanagement of funds, or by no funds being available in certain instances, are the main driving forces here. Also a lack of capacity to properly maintain the assets.

3.9.4 General Implications

Poor service delivery, and shortage of water in extreme cases is a result of deteriorating infrastructure.
In South Africa, studies have shown that a large percentage of rural water treatment plants do not comply with the required drinking water quality standards.

3.9.5 Implications for the water industry

Water supply authorities will not be able to ensure continued provision of acceptable quality water.

The consumers will have less confidence in the water supply authorities, and increased use of point-of-use systems and bottled water will prevail. This is currently the situation in South Africa. The problem is being addressed on a national scale.

Donors may become tired of continually having to fund solutions for Africa's many problems and shift from the donation of funds to market (investment and commercial) opportunity funding.

3.9.6 Adaptive Strategies

Asset management programs should be improved.
Also te receive high priority are capacity building in preventative maintenance programs and management thereof by the authorities, funding allocation on a priority basis, and providing capacity to improved project and financial management.

3.9.7 Conclusion

There is an increasing deterioration of water supply and sanitation infrastructure in sub-Sahara Africa, and it is expected to continue in future. The consumers have less confidence in the water supply authorities, and increased use of point-of-use systems and bottled water will prevail (mostly in urban areas).

3.10 Political Tensions over Water

3.10.1 Introduction

Type of factor: Political.
A culture of non-payment has resulted in poorer service delivery, which has become highly politicised in certain communities in Southern Africa. Poor management of resources by the water service providers has also resulted in poorer service delivery and dissatisfaction of consumers. The trend is expected to continue throughout Africa.

3.10.2 Definitions

Inherit tensions over equitable and adequate water provision for human, economic and ecosystem needs. In South Africa, free basic water (first 6000 L per household per month) and increased regulation of agricultural use of water.

3.10.3 Driving Forces

- Economic status of the country (poverty levels).
- Availability of raw water sources.
- Perceptions of consumers.

3.10.4 General Implications

- Poor service delivery (due to a number of reasons) is leading to loss of confidence in the authorities and the ruling party.
- Creation of polarisation between affluent and marginalised communities.

3.10.5 Implications for the water industry

- Increased perception of the value of water. Affluent consumers are generally prepared to pay more for better quality water.

- Improved water demand management methods needed.

- Intervention by central government to ensure better service delivery and regain the confidence of consumers in (especially) problems areas.

- Partisan political interests prevent regional collaboration between countries, while party politics within many countries use access to water to force political support.

3.10.6 Adaptive Strategies

- Increasing need for science and technology to provide relevant technical input to help inform decision-making.

3.10.7 Conclusion

A culture of non-payment has resulted in poorer service delivery, which has become highly politicised in certain communities in South Africa. Poor management of resources by the water service providers has also resulted in poorer service delivery and dissatisfaction of consumers. The trend is expected to continue throughout southern Africa.

4 Conclusions

The main conclusions from the questionnaires and strategic sessions on future drinking water supply in sub-Sahara Africa is summarised below.

Social
There will be an increased drive to supply remaining people without water, including an increased drive to provide remaining Free Basic Water (no charge). In general there will be a greater accent on affordability, where the people and their needs will become more important.

Economical
Sub-Sahara Africa remains very poor and there will be greater pressure to produce and supply more affordable water. The high population growth and urbanisation trend will put increased pressure on improved water demand management – also on household level. Greater emphasis will be on low running cost technology (people pay the running costs), and integrated with this will be pressure to produce and utilize renewable energy sources at a lower cost.

Political
More political pressure will be exerted to develop and exploit alternative water and energy sources. The impact of global warming will be substantial, leading to water shortages in certain areas and flooding in other areas.

The quality of the drinking water for the immune deficient and vulnerable will become important.

The skills shortage on the sub-continent will continue.

Technological
Membranes are becoming increasingly important in light of increased pollution, and renewable energy technologies will be required. Improved and economical water harvesting methods will also be required.

There will be higher demands on treatment plants for removal of increased levels and variety of chemicals and microbiological contaminants (including the increasing NOM levels in surface waters). Consequently, newer bio-technologies will play an increasing role in the water sector.

Nanotechnology will take off on large scale and this will present enormous opportunities in the water field. High development costs will further force adaptation of international technologies to South African conditions.

Continued skills shortage will increase automation and telemetric-control of plants.

Environmental
Droughts are becoming more of a problem as water resources become overused and global warming starts to have an effect. Pollution of water resources will become worse as resources become overused. Anthropogenic chemicals in the environment will become more of an issue (EDC's, drugs, beauty care products, industrial chemicals). Management of water-related wastes will become a bigger issue.

The most important trends that will affect South Africa and sub-Sahara Africa are:

- high population growth and large-scale urbanisation
- deterioration of source water quality
- climate change and its effect on sustainable water supply
- the cost and availability of energy

Africa's Future Challenges
From 31 May to 2 June 2006, Cape Town hosted the 16th World Economic Forum on Africa, attended by approximately 700 political, business and civil leaders from around the world, who engaged in discussions regarding Africa's future opportunities and challenges on the trail of its sustainable growth path. The three days gave rise to numerous discussion sessions on topics regarding energy, health, hunger, finance and business relationships, to review the past year's progress and develop strategies on how to facilitate this year's theme of "going for growth".

A prominent subject matter of the WEF's Africa Business Summit was the commercial role of China in Africa. It occupied both formal and informal discussion throughout the event.

Even though the number one Millennium Development Goal, to halve poverty by 2015, seems somewhat remote, the African continent has made vast leaps forward over recent years. Peace and macroeconomic stability, coupled with Asian demand for natural resources, and the resulting commodity price boom, have lifted growth across Africa to 30-year record rates of 5.5% for 2005.

To sustain present growth levels, the forum's focus shifted towards a development strategy for "growth" through trade and investment relations, to enhance living standards and lift the continent out of dismal poverty and infamous unemployment levels. As noted by William Easterly of New York University, banking on prior strategies such as aid payments and handouts will not solve Africa's poverty quandary. Rather, a stable political, monetary and fiscal environment, and nurturing investment in physical, human and social capital, will bear fruit for the continent. It is "home-grown growth" driven by the private sector in key areas such as agriculture, manufacturing, infrastructure, skills development, mobile and ICT sectors that should become a focus of African economies. Two countries in the spotlight throughout the summit were China and India, the "Asian Drivers", who,

through increased urbanisation and industrialisation of their own economies, have made Africa a prominent a prominent participant in the global economy. In search of meeting their energy and raw material needs, the Asian powerhouses' "African safari" has been proving there is business to be done on the continent.

5 Appendix: Questionnaire

Appended as a separate file