



# ENVIRONMENTALLY SOUND TECHNOLOGY IN WATER RESOURCES MANAGEMENT ~ESTW 2006~

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**Dr. A. Turton** - Council for Scientific and Industrial Research, South Africa

## TUTORIAL PRESENTER

**Prof. David Stephenson** - University of Botswana, Botswana

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**D. Stephenson** – University of Botswana, Botswana  
**A.E. Taigbenu** – University of the Witwatersrand, South Africa  
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**W.M. Zahid** – King Saud University, Saudi Arabia

## PROGRAM OVERVIEW

### Sunday, September 10, 2006

17:00 - Registration  
18:30 (GICC Pre-Function Area)

18:00 - Welcome Reception  
19:00 (Tsodilo B Rooms 1&2)

### Monday, September 11, 2006

07:45 Registration  
09:00 (GICC Pre-Function Area)

09:00 - Opening Ceremony  
10:30 (Tsodilo C Room)

10:30 - Coffee Break  
11:00 (GICC Pre-Function Area)

11:00 MSO Keynote Address -  
"Operational Research for  
Development in Africa"  
(Tsodilo C Room)

12:00 - Lunch  
14:00 (Livingstones Restaurant)

14:00 Session 1 - Wastewater and  
Stormwater Management  
(Moremi 1&2 Rooms)

15:00 - Coffee Break  
15:30 (Grand Palm Convention Rooms  
Pre-Function Area)

15:30 Session 1 Continued

16:15 Optional Evening Tour -  
"Botswana BBQ and Game  
Drive"  
(Meeting Place: Main Entrance  
GICC)

### Tuesday, September 12, 2006

08:30 Tutorial Presentation -  
"Sustainable Management of  
Surface Water Resources in Arid  
Catchments"  
(Moremi Suite)

09:30 - Coffee Break  
10:00 (Grand Palm Convention Rooms  
Pre-Function Area)

10:00 Tutorial Presentation Continued

12:00 - Lunch  
14:00 (Livingstones Restaurant)

14:00 Keynote Address - "Water and  
Environmental Management in  
Water Challenged Developing  
Countries with a Mining-based  
Economy"  
(Moremi Suite)

15:00 - Coffee Break  
15:30 (Grand Palm Convention Rooms  
Pre-Function Area)

15:30 Session 2 - Integrated  
Watershed Management  
(Moremi Suite)

19:00 Dinner Banquet  
(Tsodilo B Room)

### Wednesday, September 13, 2006

08:30 Session 3 - Water Supply and  
Sustainable Use  
(Moremi Suite)

10:30 - Coffee Break  
11:00 (Pre-Function Area)

11:00 Session 3 Continued

12:00 - Lunch  
14:00 (Livingstones Restaurant)

14:00 Session 4 - Issues in  
Implementing Environmentally  
Sound Technologies  
(Moremi Suite)

15:00 - Coffee Break  
15:30 (Grand Palm Convention Rooms  
Pre-Function Area)  
15:30 Session 4 Continued  
17:30 Closing Ceremony  
(Okavango 1 Room)

**Thursday, September 14, 2006**

07:30 - Optional Full Day Tour -  
18:00 "African Adventure Day"  
(Meeting Place: Grand Palm  
Main Entrance)

**PLEASE NOTE**

- ❖ Paper presentations are 15 minutes in length with an additional 5 minutes for questions.
- ❖ Report to your Session Chair 15 minutes before the session is scheduled to begin.
- ❖ Presentations should be loaded onto the presentation laptop in the appropriate room prior to your session.
- ❖ End times of sessions vary depending on the number of papers scheduled.

**SUNDAY,  
SEPTEMBER 10, 2006**

**17:00 – 18:30 REGISTRATION**

*IASTED Staff: Nadia Leamy  
(Canada)*

*Room:(GICC Pre-Function Area)*

**18:00 – 19:00 WELCOME  
RECEPTION**

*Room: (Tsodilo B Rooms 1&2)*

**MONDAY,  
SEPTEMBER 11, 2006**

**07:45 – 09:00 REGISTRATION**

*IASTED Staff: Nadia Leamy  
(Canada)*

*Location: GICC Pre-Function Area*

**09:00 – 10:30 OPENING  
CEREMONY**

*Presenter: Honourable Mrs.Pelonomi  
Venson Moitoi (Botswana)*

*Room: Tsodilo C*

**10:30 – 11:00 COFFEE BREAK**

*Location: GICC Pre-Function Area*

**11:00 – KEYNOTE ADDRESS –  
“OPERATIONAL RESEARCH  
FOR DEVELOPMENT IN  
AFRICA”**

*Presenter:T. J. Stewart (South Africa)*

*Room: Tsodilo C*

The conventional development of operational research (OR) in the developed world has been highly successful in improving the economic efficiency and/or competitiveness of large organizations. A review of the prize winning papers for the prestigious Edelman practice prize of the Institute for Operations Research and the Management Sciences (INFORMS) demonstrates the manner in which various OR models have led to dramatic savings or profit increases in areas such as scheduling, routing, and production. We shall argue, however, that in the developing world, the critical areas of application of OR relate more to problems of effectiveness and delivery than simply to economic efficiency. This substantially changes the character of OR, requiring consideration of highly diverse objectives, and an integration of "softer" types of modelling with the "harder" mathematical modelling. These unique characteristics of OR in development will be illustrated by describing applications of OR to water resources planning and to allocations of fishing rights in South Africa. This experience has particular relevance when it is recognized that the existence of both highly developed and undeveloped sectors in this country makes it in many senses a microcosm of the world at large.

**Theodor Stewart** is professor of statistical sciences at the University of Cape Town, with specialization in operational research and decision analysis. He had trained as a chemical engineer and worked for a number of years in the mining and chemical industries before joining the South African Council for Scientific and Industrial Research where he was responsible for creating an integrated division for operations research and statistics. He has been at the University of Cape Town since 1984, where he was head of the department of statistical sciences from 1994-1999. His research interests are largely in the field of multiple criteria decision analysis and its application to natural resource management. He is president of the International Society for Multiple Criteria Decision Making and vice-president of the International Federation of Operational Research Societies with responsibility for the Developing Countries program.

### **12:00 – 14:00 LUNCH**

*Location: Livingstones Restaurant*

### **14:00 – SESSION 1 – WASTEWATER AND STORMWATER MANAGEMENT**

*Chairs: R. Hranova (Botswana) and  
H. MacMurray (New Zealand)*

*Room: Moremi Rooms 1& 2*

515-034

Physical and Numerical  
Modelling to Support  
Management of Water and  
Sediment Flows in the Shotover  
and Kawarau Rivers,  
Queenstown, New Zealand

*H.L. MacMurray, T.R. Davies, and  
S. Ruddenklau (New Zealand)*

515-035

A Potential Shortcoming of Event-  
based Design for Stormwater  
Detention Systems

*M. Pennington (New Zealand)*

515-054

Centralized Municipal  
Wastewater Reuse Projects in  
Arid Areas with Emphasis on the  
Planning Process

*R. Hranova (Botswana)*

515-805

Stormwater Management in  
Informal Settlements

*G. Lebitsa, O. Pule, and*

*D. Stephenson (Botswana)*

### **15:00 – 15:30 COFFEE BREAK**

*Location: Grand Palm Convention  
Rooms Pre-Function Area*

## **15:30 - SESSION 1 CONTINUED**

### **16:15 - OPTIONAL EVENING TOUR - "BOTSWANA BARBEQUE AND GAME DRIVE"**

*Meeting Place: Main Entrance GICC*

*Time: 16:15*

Our group will set out on our journey just before sunset to the Mokolodi Nature Reserve for a 2-hour game drive. Refreshments will be available upon arrival and then you can relax and enjoy the sights. Following the game drive we will be served hot soup and a full hot Braai menu, including dessert. This will be served around a cozy fire as we enjoy entertainment provided by the Ditshwene traditional dancers.

## **TUESDAY, SEPTEMBER 12, 2006**

### **08:30 - TUTORIAL PRESENTATION - SUSTAINABLE MANAGEMENT OF SURFACE WATER RESOURCES IN ARID CATCHMENTS**

*Presenter: D. Stephenson (Botswana)*

*Room: Moremi Suite*

The problems of storing water in reservoirs in arid areas will be discussed and analysed. For example, only about a quarter of river flow into dams in Botswana can be usefully diverted. The rest either evaporates, or during flood periods, flows over the spillway and eventually reaches the sea. Computer models of the various dams have indicated that more water is lost from these dams through evaporation than is made available for use. The problem is that the water has to be stored for long periods because the interval between droughts is irregular, and in fact is often many years. Surface area of our dams is large because of the terrain. The evaporation loss could be minimised by keeping the level of the dams low, but then the danger of them running dry becomes greater. Therefore the solution would be to use the dams as much as possible, thereby keeping the level low and maximising the yield, provided that there is a backup during extreme droughts. That backup could be groundwater or purified wastewater, or a combination of both. In this way, the amount we abstract from the groundwater source could be, on average, considerably below the natural recharge rate and therefore the aquifers would be operated on a sustained basis. The increase in yield of the system as a whole is largely because of the reduction in

evaporation from the surface reservoirs. It would also be possible to increase the yield of our dams by juxtaposing one against another. It is often the case that there is excess water in the North, i.e. inflow into the Shashe and Letsiboga Dams, when there is drought in the South, i.e. inflow into Gaborone Dam. In that case it would be possible to transfer the excess from the North to the South.

**David Stephenson** is a Professor of water engineering at the University of Botswana. He is also a Professor Emeritus at the University of Witwatersrand and a Visiting Professor at the University of Stuttgart. He is on the Council of the International Association of Hydraulic Engineering and Research and Chairman of the African Division. Dr. Stephenson is also the author of 10 books and 180 papers in water engineering and is called on internationally to advise on water resources development.

#### **09:30 – 10:00 COFFEE BREAK**

*Location: Grand Palm Convention Rooms Pre-Function Area*

#### **10:00 – TUTORIAL PRESENTATION CONTINUED**

#### **12:00 – 14:00 LUNCH**

*Location: Livingstones Restaurant*

#### **14:00 – KEYNOTE ADDRESS – “WATER AND ENVIRONMENTAL MANAGEMENT IN WATER CHALLENGED DEVELOPING COUNTRIES WITH A MINING-BASED ECONOMY”**

*Presenter: A. Turton (South Africa)*

*Room: Moremi Suite*

South Africa has the strongest economy and arguably also the most robust science and technology-base in the region. It is also a mineral rich region where mining forms the basis of the economy. However, the history of colonialism has had a sad and complex impact on the region, not the least of which was related to the mining sector. Confronted by the need to achieve rapid economic development in the face of growing international isolation, the Apartheid State made a decision in 1960 to accelerate mining on the Far West Rand at the expense of agriculture. Embodied in the so-called *Jordaan Commission Report*, the Goldfields of the Far West Rand were dewatered, exposing the richest body of gold ore known to mankind. Associated with the gold ore, was uranium, a key element of the Manhattan Project and thus a strategic trump card for the embattled Apartheid State.

Now, half a century later, it is becoming evident that heavy metal contamination and unmanaged radioactivity is an environmental externality that was never considered at the time. When democracy came to South Africa in 1994, changes were made *inter alia* to the management of research funding, and a decade later the first body of public domain literature bears testimony to the endeavours of a liberated scientific community. One report in this emerging new literature is what the increasingly embattled mining industry has dubbed the *Infamous 1214*, with reference to the Water Research Commission Report No. 1214 of 2006. This report is likely to become a watershed in environmental management in South Africa for reasons to be presented in the Keynote Address. All actors are facing major challenges - the Government has the responsibility of undoing the damage of the past if it is to remain true to its Constitutional commitments, the scientific community races to play catch-up in areas that were previously off limits to public-domain research, and industry as it forges new relationships with its regulatory and oversight structures brought about by the democratic process.

**Anthony Turton** is a specialist in transboundary water resources,

particularly where these are contested in some way. With a professional history supporting negotiations in highly contested circumstances, this core skill is being brought to bear in the field of environmental and water resource management. Anthony is a founding member and currently President of the Universities Partnership for Transboundary Waters, a consortium of ten universities on five continents. Serving on the editorial boards of Springer Verlag and the International Journal of Water Resources Development, and active in various Think Tanks including the Woodrow Wilson Centre for International Scholars in Washington D.C., and the Expert Group on Development Issues (EGDI) in Stockholm, Anthony has an international profile. Widely published in the field of transboundary water resource management. Anthony's current interest is in governance with an edited volume in press entitled, *Governance as a Dialogue: Government-Society-Science in Transition* (Berlin: Springer-Verlag). Anthony has a Doctorate from the University of Pretoria and is Research Group Leader in the Water Resource Competency Area at the Council for Scientific and Industrial Research (CSIR) in South Africa.

**15:00 – 15:30 COFFEE BREAK**

*Location: Grand Palm Convention  
Rooms Pre-Function Area*

**15:30 - SESSION 2 -  
INTEGRATED WATERSHED  
MANAGEMENT**

*Chairs: R. P. Hämäläinen (Finland)  
Room: Moremi Suite*

515-018

Getting the Most out of  
Botswana's Rivers  
*D. Stephenson (Botswana)*

515-029

Web-based Decision Support in  
Water Resources Management  
*J. Mustajoki, R.P. Hämäläinen, and  
M. Marttunen (Finland)*

515-030

Preliminary Conceptual Model of  
the GIS based Rainwater  
Harvesting Decision Support  
System  
*J. Mwenge Kahinda, E.S.B. Lillie,  
R.J. Boroto, R. Dube, and  
A.E. Taigbenu (South Africa)*

515-038

The Effect of Climate Variability  
and Land Use Land Cover on the  
Runoff Characteristic of Limpopo  
Basin, Botswana  
*B.P. Parida, D. Kgaodi,  
D.B. Moalafhi, and O.P. Dube  
(Botswana)*

515-803

The Dwindling Lake Victoria  
Water Level  
*B. T. Mangeni (Uganda)*

**19:00 - DINNER BANQUET**

*Location: Tsodilo B*

**WEDNESDAY,  
SEPTEMBER 13, 2006**

**08:30 – SESSION 3 – WATER  
SUPPLY AND SUSTAINABLE  
USE**

*Chairs: TBA  
Room: Moremi Suite*

515-022

Water Quality Variation within a  
Distribution System: A Case  
Study of Eldoret Municipality,  
Kenya  
*J.M. Ndambuki (South Africa)*

515-023

Precision Farming: A Water  
Management Tool?  
*P.A. Kagoda (South Africa)*

515-032

Modelling Responses of Savanna  
Grass Species to Water Supply  
and Competition  
*J. Segarra, J. Raventós, M. Acevedo,  
and J.F. Silva (USA)*

515-036

The Institutional Challenge in the Implementation of Water Demand Management: A Case of the City of Bulawayo, Zimbabwe  
*M. Ncube and A.E. Taigbenu (South Africa)*

515-041

Water Pricing: A Key to Sustainable Water Supply and Demand Management in Southern Africa: A Comparative Study of Botswana and Zimbabwe  
*W.L. Hambira (Botswana) and C.P. Gandidzanwa (Zimbabwe)*

515-043

Predicting the Role of Antioxidants and Irrigation on Sunflower Yield Grown under Saline Conditions  
*M.S. Gaballah, S.A. Ouda, M.S. Mandour, and M.M. Rady (Egypt)*

515-047

Forecasting Water Demand for Effective Water Management During Drought Periods in the Greater Gaborone Area, Botswana  
*P.K. Kenabatho and B.P. Parida (Botswana)*

515-051

Determination of Sustainable Wellfield Yield Considering Groundwater-Surface Water Interaction  
*J. Kotze, G. van Tonder, I. Dennis, and S. Zimmermann (South Africa)*

515-802

Water Productivity of Food Crops in Gezira Scheme, Sudan  
*A.M. Adeeb (Sudan)*

515-804

Water Quality Assessment in Al Jabal Al Akhdar Region of Oman for Sustainable Water Resources Management  
*M. Ahmed, R. Victor, M. Al-Haddabi and J. Al-Handhali (Oman)*

515-808

Water Resources Management in Botswana Under the Increasing Effects of Climate Change  
*U.T. Umoh (Botswana)*

### **10:30- 11:00 COFFEE BREAK**

*Location: Grand Palm Convention Rooms Pre-Function Area*

### **11:00 - SESSION 3 CONTINUED**

### **12:00 - 14:00 LUNCH**

*Location: Livingstones Restaurant*

### **14:00 - SESSION 4 - ISSUES IN IMPLEMENTING ENVIRONMENTALLY SOUND TECHNOLOGIES**

*Chair: T. Hiley (Australia)*

*Room: Moremi Suite*

515-033

Sustaining Life -Learning and (More Than) Water  
*J. Goricane and T. Hiley (Australia)*

515-037  
Soil Moisture Modelling and  
Application in Agricultural Water  
Management

*B.F. Alemaw, T.R. Chaoka, and  
O. Totolo (Botswana)*

515-039  
Lex's Story – The Application of  
Appropriate Water Technology in  
the Highlands of Rural Kenya

*T. Hiley, M. Hiley (Australia), and  
L. Rutherford (Kenya)*

515-040  
An Overview of Prepaid Water  
Meters in Botswana

*L. Amusa, R. Chanda,  
M.A. Mpotokwane, and E. Segosebe  
(Botswana)*

515-800  
The Effect of Platinum Mining on  
Surrounding Soils and Vegetation:  
A preliminary Assessment

*M.S. Maboeta, S.J. van Wyk,  
L. van Rensburg, and  
P. Jansen van Rensburg  
(South Africa)*

#### **15:00 – 15:30 COFFEE BREAK**

*Location: Grand Palm Convention  
Rooms Pre-Function Area*

#### **15:30 - SESSION 4 CONTINUED**

#### **17:30 – CLOSING CEREMONY**

*Room: Okavanago 1*

## **THURSDAY, SEPTEMBER 14, 2006**

### **07:30 – 18:00 - OPTIONAL FULL DAY TOUR – “AFRICAN ADVENTURE DAY”**

*Meeting Place: Grand Palm Main  
Entrance*

*Time: 7:30*

Travelling in small buses we will drive through a game reserve to see exotic animals such as antelope, monkeys, rock hyrax and prolific bird-life. Our travels will then take us into the centre of Gaborone, where we will visit the National Museum and Art Gallery. There is an opportunity to take a short walk to the busy Main Mall to the Parliament buildings, giving you a chance to see across-section of Botswana life and a plethora of arts and crafts vendors. In the afternoon we will proceed to the Gabane village to see local pottery, glass works, art and a company producing creams, lotions and herbal remedies from local plants.

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**IASTED would like to thank you  
for attending ESTW 2006. Your  
participation helped make this  
international event a success, and  
we look forward to seeing you at  
upcoming IASTED events.**

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