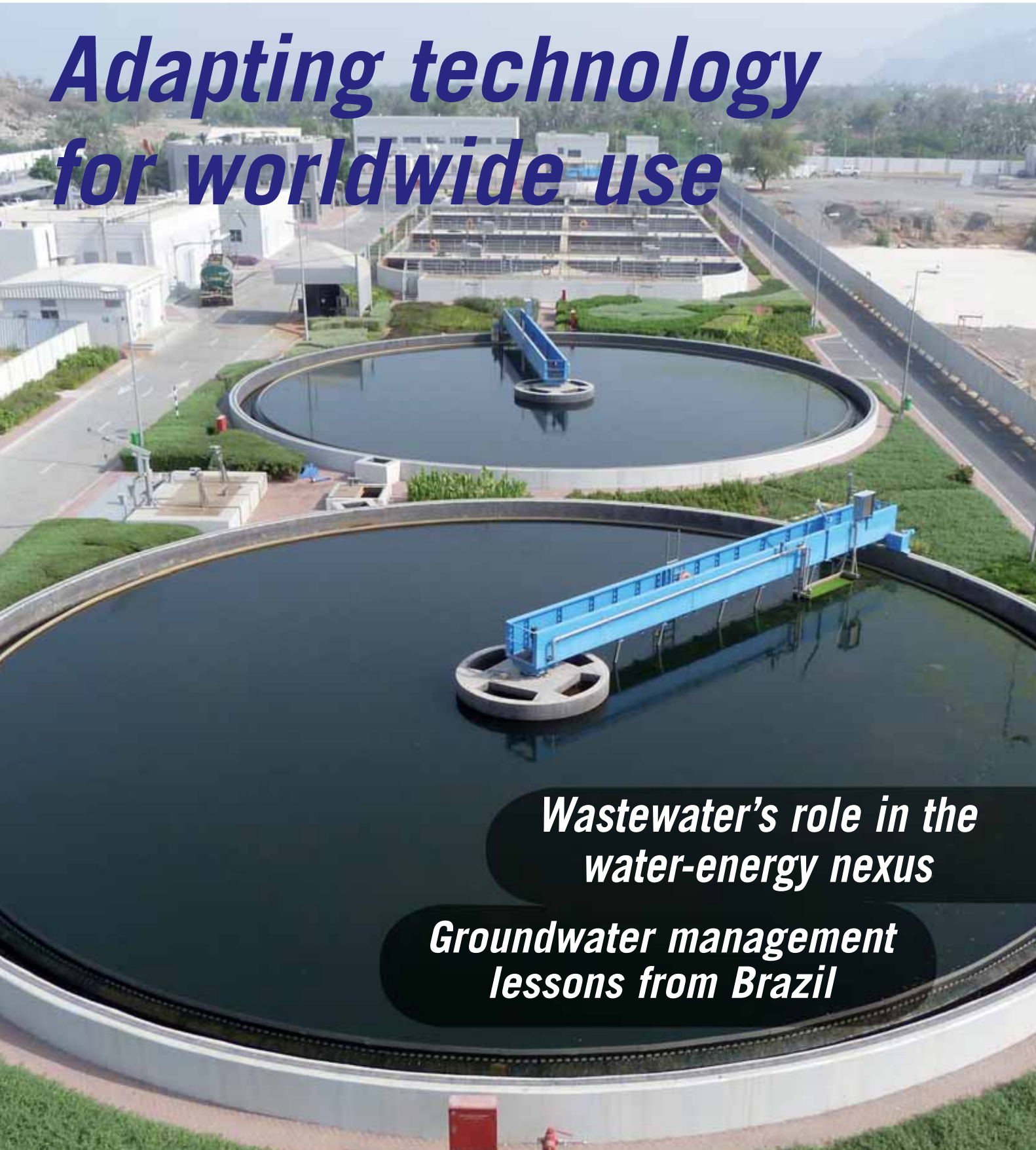
Adapting Technology for Worldwide Use - Special Issue

water21

April 2012

Magazine of the | International Water Association

Adapting technology for worldwide use



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Editor
Keith Hayward
khayward@iwap.co.uk

Assistant Editor
Catherine Fitzpatrick
cfitzpatrick@iwap.co.uk

Contributing Editors
Bill McCann, Lis Stedman

Publisher
Michael Dunn

IWA & Editorial Address
Alliance House, 12 Caxton St,
London SW1H 0QS, UK.
T: +44 (0)20 7654 5500
E: publications@iwap.co.uk
W: www.water21online.com
W: www.iwahq.org

Advertising
Contact the advertising team at:
Caspian Media
Unit G4, Harbour Yard, Chelsea
Harbour, London, SW10 0XD, UK
T: +44 (0)20 7045 7612
E: water21advertising@
caspianmedia.com

Water21 is published six times a year by IWA Publishing (address as above). Statements made do not necessarily represent the views of IWA or its Governing Board.
Water21 is received by all members of IWA (see IWA website for fees). Institutional (library) subscription rate (2012) is £306/US$562/€488 (including online access), from:

Portland Customer Services,
Commerce Way, Colchester,
CO2 8HP, UK
T: +44 (0)1206 799351
E: sales@portland-services.com

Design & layout:
IPL Print & Design Ltd
Print: Warners Midlands plc

ISSN 1561-9508

Why the name 'Water21'? 'The general objective is to make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity of nature and combating vectors of water-related diseases. Innovative technologies, including the improvement of indigenous technologies, are needed to fully utilize limited water resources and to safeguard those resources against pollution.' From 'Agenda21', the UN programme of action from the Rio Earth Summit, 1992.

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COVER STORY

The German Federal Ministry of Education and Research has been financing a wide range of projects looking into adapting established technologies to the conditions of other countries. Hermann Orth and Peter Wulf discuss work on wastewater treatment, nutrient recovery and wastewater reuse technologies and how they could be adapted for use around the globe.

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Photo shows an example of an activated sludge process plant in high-temperature conditions: Fujairah wastewater treatment plant (100,000 PE, UAE). Credit: Emscher Gesellschaft fuer Wassertechnik mbH.

REGULARS

IN THIS ISSUE...

Water and energy are strongly interlinked, with water and wastewater treatment requiring large amounts of energy, and large amounts of water required to generate electricity. In a rapidly urbanising world, Valentina Lazarova, Kwang-Ho Choo and Peter Cornel discuss the opportunities available from reusing wastewater, for both water and energy.

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FEATURES

GLOBAL FOCUS

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RAINWATER HARVESTING

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EUROPE

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CONTROL & AUTOMATION

GROUNDWATER

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Supply progress confirmed amid concerns over safety

UNICEF and the WHO have issued a report on progress in drinking water and sanitation that reveals that, as of 2010, the drinking water MDG has been met.

The report delves in detail into the situation around the globe, disaggregating some data and revealing trends for the first time. Among these, it notes that sub-Saharan Africa is lagging behind – coverage of improved water supply sources is 90% or more in Latin America, Northern Africa and large parts of Asia, but is just 61% in sub-Saharan Africa.

Coverage in the developing world overall stands at 86% but is only 63% in countries designated as 'least developed'. The report also cautions that complete information about drinking water safety is not available for global monitoring so a proxy indicator of the proportion of the population with access to an 'improved' drinking water source was used.

However, the report notes, some sources may not be adequately maintained and therefore may not actually provide 'safe' drinking water.

It also confirms that the sanitation target is well out of reach – at current rates of progress the world will reach 67% coverage in 2015, far from the 75% needed to meet the MDG. However, the report adds that 'encouraging progress is being made', with 1.8 billion extra people using improved sanitation since 1990, which means the world is within 10% of being 'on track'.

Humanitarian body Solidarites International strongly supported the drinking water caveat, warning that the announcement was 'too good to be true' and that it 'is far from the reality experienced by billions of people with no access to drinking water or sanitation'.

The organisation noted in a statement: 'This is a very handsome announcement on the eve of the 6th World Water Forum, and one we could be delighted about if the reality were not completely different.'

Gregory Bulit, a water, hygiene and sanitation expert at Solidarites International, said: 'As the experts from WHO and UNICEF (both of which are our NGO's operational partners) know, an improved water source, which is protected from contamination and in particular from faecal matter when it is built, will not necessarily remain that way.

'This poses the question of true water quality, but also of how water is stored (which can also be a source of contamination), of access to this water in terms of price and distance, not to mention the data collection methods used to draw up this status report on drinking water access.'

Relief agency Tearfund welcomed the news, but warned that this is no time for complacency. Laura Taylor, Tearfund's head of public policy, said, 'We must not forget that nearly 800 million people still don't have clean safe water and 2.5 billion live without toilets. There are still huge disparities across and within countries.' ● **LS**

(See Analysis, p10)

Industry endorsement of US water financing authority proposals

In a statement to a US senate subcommittee, AWWA, AMWA and WEF, three of the US's major water organisations, have endorsed draft legislation that would create a Water Infrastructure Finance and Innovation Authority (WIFIA) to reduce the cost of water infrastructure projects for utility customers.

Speaking before the US House subcommittee on water resources and environment, which is considering legislation to create the body, Aurel Arndt, the general manager of Leigh County Authority in Allentown, Pennsylvania, said WIFIA 'would fill a significant gap between what current water infrastructure tools can do and what needs to be done'.

WIFIA would reduce the cost of local water infrastructure projects at little or no long-term cost to the federal taxpayer, he added. The mechanism would borrow US Treasury funds at near-Treasury rates to provide low-interest loans, loan guarantees, or other credit support to local communities.

Leaders of both AWWA and WEF testified in support of the legislation. A further hearing was planned as *Water21* went to press.

Loan repayments with interest and guarantee fees would flow back to WIFIA and into the Treasury, again with interest. Eligible water infrastructure projects would include water, wastewater, and wet weather related projects.

Mr Arndt added: 'In short, WIFIA will allow our nation to build more water infrastructure at less cost. And to top that, we will get a cleaner environment, better public health and safety and a stronger foundation for our economy.'

AWWA's testimony stressed that it strongly believes the cornerstone of water infrastructure finance should remain local rates and charges. However, Mr Arndt added, there are periods in time when large infusions of capital are needed, such as when large amounts of pipe must be replaced or a treatment plant must be upgraded due to age or new regulations.

Mr Arndt concluded: 'A number of water infrastructure tools have been sincerely proposed over the years, but WIFIA is the one that best targets the real needs of communities, makes the most fiscal sense, and that will have the most impact on our nation's water infrastructure.'

AWWA says the leverage ratio of a typical water infrastructure could be even higher than that of a transportation project (approximately 10 to one) due to the comparative fiscal responsibility of water borrowers. AWWA, WEF and the Association of Metropolitan Water Agencies estimate that a $400 million federal appropriation could cover at least $4 billion in WIFIA credit assistance, based on Congressional Budget Office guidelines.

AWWA manager of legislative affairs Tommy Holmes said that WIFIA is not intended to be a 'silver bullet' that will solve all of the US's water supply and infrastructure problems: 'Water is obscenely cheap in this country, and even with WIFIA I think we're going to have to see some rates increase. We don't see WIFIA displacing any other tools. There will still be a role for the SRF (state revolving fund) program and the bond market.' ● **LS**

UN sets out latest global water assessment

The UN system has released its latest comprehensive global assessment of water issues, identifying key messages to carry forward to the forthcoming UN 'Rio+20' sustainable development summit taking place in June.

The fourth UN World Water Development Report argues in particular that, while the world faces a crisis on a number of issues, these are all underpinned by water.

The report was launched by UN-Water, the UN system's inter-agency coordination mechanism on water, at the World Water Forum in Marseille, France, in March. The report notes that many of the areas of development, such as food, health, energy, industry, trade and the economy, face a crisis. It concludes: 'The WWDR4 reveals that the path to solving these crises flows through water, and that solving water problems now is necessary to ensuring chances for the future of our planet and the prosperity of its people.'

According to UN-Water, the overall message of the latest report is that, with unprecedented growth in demands for water threatening all major development goals, a radical rethink is needed in the way water is managed. 'UN-Water will bring the important messages of this UN-Water Report to the Rio+20 Summit in June 2012,' commented Michel Jarraud, Chair of UN-Water, in a statement released for the launch of the report.

The report highlights the increasingly global dimensions of water, particularly in relation to climate change, trade and foreign investment. It therefore points to the opportunities presented for action through the UN Commission on Sustainable Development, the UN Framework Convention on Climate Change, and the post-2015 activities in relation to the Millennium Development Goals.

Subtitled 'Managing water under uncertainty and risk', much of the report is dedicated to setting out how uncertainty and risk shape the way in which water management needs to be approached, in particular the need for water to be valued and to ensure that water management institutions are able to be adaptable. ● **KH**

(See Analysis, p10)

OECD view of 2050 prompts call for urgent action

The latest environmental outlook from the Organisation for Economic Co-operation and Development offers a scenario in which the Earth's population is expected to increase to 9 billion, the world economy is expected to quadruple, and energy use is projected to rise by 80%. Urgent action is needed now if the significant economic and human costs that can be expected from 'business as usual' are to be avoided.

'OECD Environmental Outlook to 2050: the consequences of inaction' anticipates a 55% increase in global water demand by 2050 and an approximate tripling of nitrogen in effluents over the same period, with the deterioration in water quality occurring primarily in non-OECD countries.

'This set of projections point to the need for governments to embark on a very significant and wide-reaching water reform agenda,' said Anthony Cox, Head of the Environment and Economy Integration Division of OECD's Environment Directorate.

The outlook is based on joint modelling by the OECD and the PBL Netherlands Environmental Assessment Agency. Nearly 70% of the world's population is expected to live in urban areas by 2050, with the manufacturing sector expected to see the greatest increase in its demand for water – rising by 400%.

Commenting on the range of water reforms needed, Cox pointed out that improvements to water quality will come from coupling wastewater collection with treatment, but that this needs to be supported by more rapid dissemination of innovations. Speaking at the World Water-Tech Investment Summit held in London at the end of February, he said there is a need for policy coherence across all areas, particularly the 'silos of government policy' relating to the recognised nexus of water, energy and agriculture.

The long-term challenges identified in the new assessment compound the difficulties that already exist in terms of securing adequate and sustainable financing for water supply and sanitation, particularly because of the global financial crisis.

'There is a real challenge going forward with the financing aspects in terms of repayable market finance as a result of the crisis,' said Cox. This is against a backdrop of huge investment needs in water supply and sanitation – total investment in OECD countries is put at some $580bn a year, but needs to double by 2025 according to OECD estimates. 'It is a huge sleeper issue in OECD countries and most governments have not come to grips with this in a very adequate way,' added Cox.

Other areas in which actions are needed include water data, water efficiency, and the use of green infrastructure.

'There is a big role we believe for the use of green infrastructure,' said Cox. ' By this I mean making greater use of the natural resilience of ecosystems to deal with many of the water quality issues that we have, [and] restoring the ecosystem functions of wetlands and floodplains. We also need to have a greater investment in water storage capacities to improve our water security.' ● **KH**

ADB raises climate-induced migration concerns

The ADB has issued a report on addressing climate change and migration in Asia and the Pacific that warns climate-induced migration must be addressed as part of the development agenda given the major implications for the sustainable economic and social development of the region.

The report notes that Asia and the Pacific is the global area most prone to natural disasters, and is home to highly-vulnerable populations that are disproportionately poor and marginalized.

Migration will occur within and between countries. To reduce climate-change driven migration and strengthen the resilience of vulnerable communities, governments should adopt policies and commit financing to social protection, developing livelihoods, basic urban infrastructure development and disaster risk management, the report concludes. ●

● A report from market analyst Frost & Sullivan reveals that depleting water reserves, particularly in the north of China, mean that the country is increasingly turning to **membrane bioreactor** technologies for water regeneration. Both municipal and industrial end users are making this their technology of choice, the report says, noting that 'considering the increasingly stringent wastewater discharge standards for various industrial sectors, MBR wastewater treatment technology is definitely the way forward'.

● **Strategic analyst Future Directions International has issued a report that warns increasing development and water consumption in AFGHANISTAN is having a negative effect on downstream Iran, increasing the latent tensions between them. The report says that the building of hydro-electric dams on the Afghan side of the shared water basins is seen by Iran as a direct security threat.**

● **Veolia Water Japan** has successfully bid to extend its operation and maintenance contracts to provide wastewater services for 649,000 people in parts of Hiroshima and 51,000 people in parts of Kyoto. The company has also won a five-year operations and maintenance contract for all drinking water facilities serving 515,000 people in Matsuyama, on the southern island of Shikoku - Veolia Water's first drinking water contract for a Japanese city.

● **South Australian premier Jay Weatherill has issued a statement on the DRAFT MURRAY-DARLING BASIN PLAN that reveals the state's analysis of the plan is nearing completion, but preliminary findings already suggest that the 2750 billion litres the plan proposes to return to the system will not be sufficient. The statement also notes that more recognition of South Australia's responsible use of the river since the state's take was capped in 1969 is needed.**

● Veolia Water India, a Veolia Water subsidiary, has been awarded a 25-year potable water service operation and maintenance contract by the **city of Nagpur in India**. For the contract, the company has set up a special-purpose entity, Orange City Water, in joint venture with one of India's leading civil engineering and services companies, Vishvaraj Environment.

● **Professor MARK VAN LOOSDRECHT has been named as the winner of this year's Lee Kuan Yew Water prize for his 'breakthrough contributions in creating sustainable solutions in the field of wastewater treatment'. The prize, which is the highlight of Singapore International Water Week, is for Professor van Loosdrecht's work on the Anammox process, which shortens the conventional treatment process and can greatly reduce overall energy consumption, chemical use and carbon emissions. Professor van Loosdrecht works at the Delft University of Technology as group leader, environmental biotechnology in the Department of Biotechnology, within the Faculty of Applied Sciences. He is also a member of IWA's strategic council.**

● The WHO and the Secretariat of the Ramsar Convention have published a new technical report, **'Healthy wetlands, healthy people**: a review of wetlands and human health interactions'. The report concludes that changes in perspectives both within and outside the field of wetland management are required to ensure human health and wetland ecosystems are managed to benefit one another. It also suggests that instruments and approaches likely to be used by the health sector to respond to health effects and the health outcomes of disruptions to ecosystem services should be understood and employed by wetland managers.

Human rights message to Rio+20 meeting

Independent UN human rights experts have urged countries to include international human rights norms and standards, as well as accountability mechanisms, in the goals that will emerge from the Rio +20 talks in June.

In an open letter to governments, the experts warn: 'Global goals are easily set, but seldom met. A real risk exists that commitments made in Rio [de Janeiro] will remain empty promises without effective monitoring and accountability.'

They added: 'Learning from the mistakes of the Millennium Development Goals, the new sustainable goals must integrate the full range of human rights linked with sustainable development, and human rights must be the benchmark for whether or not inclusive, equitable and sustainable development is occurring.'

Two decades after the original landmark Rio summit took place, the mounting effects of climate change and environmental degradation have raised the stakes, the experts said. Both the goals to be elaborated in Rio and the means of reviewing progress must be based on human rights, they added.

The experts suggested that Rio+20 should establish an international accountability mechanism similar to the UN Human Rights Council's Universal Periodic Review, which puts each country's human rights record through a state-led peer review on the basis of information submitted by the country concerned, UN entities, civil society and other stakeholders.

At a national level, governments should establish national accountability mechanisms, including independent monitoring and civil society participation, to evaluate progress towards achieving the sustainable development goals, the experts noted, warning: 'Our futures and planet are at stake, and we have three months to shape the ideas and political consensus that this huge task requires.' ●

Transboundary water concerns over agricultural land rush

Concerns over the implications for transboundary freshwaters arising from the rapid rise in acquisition and leasing of large areas of agricultural land, particularly by external countries and investors, have been highlighted in a new report published by the Stockholm International Water Institute.

The report highlights in particular that almost none of the contracts evaluated to date take account of the water needs and use implicit in the agriculture, and warns that water is often presumed to be included without it explicitly being mentioned in land lease agreements. The report refers to the 'current surge' in land acquisitions and investments by entities such as foreign countries, sovereign wealth funds and private corporations, as well as domestic investors. It notes that many investors, including India, China, South Korea, Jordan, Saudi Arabia, UAE, Kuwait and Qatar, 'are partly experiencing water shortages or are under severe water stress', with Kuwait's external water dependency put at 90%.

'Land acquisitions: how will they impact transboundary waters?', authored by Anders Jagerskog, Ana Cascao, Mats Harsmar and Kyungmee Kim, highlights in particular large-scale land acquisitions which have taken place in Africa. Large-scale investments in Ethiopia, Nigeria, Mali, Sudan, Liberia, Ghana, Madagascar and Mozambique, for example, are said to total around 11.5 million hectares. In South Sudan and Mozambique, large-scale acquisitions are put at representing 5-10% of total agricultural land, while for Liberia investments will use over 60% of the agricultural land.

'One of the first conclusions that can be drawn is the fact that the local, national, regional and global levels are interlinked, with the global rush for land acquisitions in the Southern hemisphere already having economic and political, social and water impacts (both negative and positive) at the national and local level,' the report concludes. The situation from a regional – and hence transboundary – perspective, however, is unclear as a result 'of the deals being established between foreign investors and national governments, with little or no involvement of regional organisations, such as Regional Economic Communities (RECs) or River Basin Organisations (RBOs).' The report notes that, with regard to the involvement of such organisations, 'it is likely that national governments would see this as an infringement on their sovereignty and would object.'

Other conclusions are that there is a clear trend for deals to occur in places where, amongst other things, there is weak legislation. The global water trade is expected to increase substantially, and the absence of a regional or a basin perspective in land deals might lead in the future to a clash of interests between neighbouring countries.

The report notes that there is little evidence that agricultural development is being addressed in the several instances where river basins are working on establishing institutional frameworks and commissions to deal with transboundary water issues. It also points out that the seven 'Principles for Responsible Agricultural Investments (RAI)' agreed by the UN Food and Agriculture Organization, the UN International Fund for Agricultural Development, the UN Conference on Trade and Development, and the World Bank do not explicitly mention water, stating: 'It would be useful if water was also recognised in the international principles for responsible agro-investments. Otherwise there is great risk that water rights, and impacts on water quality, may be forgotten or ignored.' ● **KH**

California's groundwater nitrate pollution 'pervasive'

A recent study from the University of California, Davis warns that nitrate contamination of groundwater is a 'pervasive' problem in California's agricultural heartlands, the Salinas valley and parts of the Central valley.

The comprehensive study, funded by the State Water Quality Control Board, identified fertilisers and animal waste as the main sources for the groundwater contamination, as a result of decades of intensive farming. It also concluded that half of the 2.6 million people living in those areas live in communities where drinking water sources have nitrate levels in excess of the state standard.

Nitrate leaching from agricultural land is responsible for 96% of the groundwater contamination, the study found. While fertiliser use has levelled off in recent years, the use of animal manure has increased, creating an overall net increase in the nitrate loading in the ground.

Data shows that farmers in these agricultural areas have been over-fertilising their crops, by almost 40% in the past decade alone.

Many communities blend or treat their waters, drill new wells or find other alternative sources, the costs for which are passed on to taxpayers. The study also found that one in 10 people in the study area are drinking untreated groundwater that may exceed the nitrate standard – small water systems and homes with their own wells are the most vulnerable.

The study warns that if no action is taken, the financial burden on many agricultural communities could increase, and by 2050 nearly 80% of the population – around two million people – in the study area could have drinking water sources with nitrate levels in excess of state standards.

Nitrate contamination will increase in future because of the considerable length of time such contaminants can take to migrate into groundwaters, the report warns. It also notes that cleaning up polluted aquifers would be too difficult, and that improved farming practices, blending, treatment and use of alternative sources are more cost effective.

Lead report author Thomas Harter suggested that state and regional water boards should help affected communities by providing legal and technical support and funding for solutions.

The report estimates that addressing the current contamination will cost $20 million to $35 million per year, and suggests a fertiliser tax, the funds from which could be used by communities to provide mitigation.

A regional water board on California's central coast also recently voted to require 3000 small farmers to test their private wells for nitrates – though the California Farm Bureau is expected to appeal the decision with the State Water Resources Control Board, which oversees the regional boards. ● **LS**

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European need for more efficient use of water resources

A new report from the European Environment Agency (EEA) warns that Europe needs to redouble efforts in using water more efficiently to avoid undermining its economy. Inefficient water use impacts hard on the resources needed by ecosystems and people, vital assets for European productivity and security, it claims.

The report, titled 'Towards efficient use of water resources in Europe', makes the case for integrated water management, starting with better implementation of existing legislation.

EEA executive director Jacqueline McGlade said: 'Water resources are under pressure in many parts of Europe, and it is getting worse. Agriculture, energy production, industry, public water supply and ecosystems are all important, and all competing for this limited resource. With climate change making water supply less predictable, it is extremely important that Europe uses water more efficiently for the benefit of all its users. Water resources should be managed as effectively as any other natural asset owned by countries.' ● (See Analysis, p11)

World Water Forum offers cooperation with ministerial support

The sixth World Water Forum in Marseille, France, held in March was the launchpad for significant initiatives and declarations, supported by a ministerial declaration urging accelerated access to safe drinking water and sanitation.

The statement reiterates ministers' commitment to achieving the Millennium Development Goals (MDGs), and pledges to accelerate the full implementation of the human rights obligations on access to safe and clean drinking water and sanitation 'by all appropriate means' as part of the efforts to overcome the water crisis.

To achieve this, the statement says that the intention is to focus efforts on local and national planning and coordination, adequate financing and investment, and robust regulatory, monitoring and accountability frameworks, involving all stakeholders.

However, Dr Alexander Likhotal, president of NGO Green Cross International, said in a statement that the declaration had 'failed to rise up to the challenges posed by the global water crisis'.

He noted: 'Contrary to the slogan of the conference, Time for Solutions, the ministerial declaration fell short exactly on solutions and is devoid of any serious, concrete plan to cope with the global water crisis. It demonstrates that the international community needs a more effective system to manage the water challenge, not triennial talkfests that achieve very little, if anything at all.'

Dr Likhotal dubbed it a 'weak and watered-down document', adding that 'this declaration only serves to state the problems and challenges, but provides no roadmap or tools to help people living in water scarcity to attain their most basic of human rights, that being access to water. It offers only a weak call to "accelerate and intensify".'

The many activities at the Forum were focused in particular around achieving progress and developing targets on a number of 'priorities for action' and 'conditions for success'. The links between water and energy formed one of the key areas given attention, with the World Water Council and the World Energy Council agreeing to work more closely in future.

Among the many events at the Forum, the UN Development Programme launched an international platform for 'global water solidarity' intended to engage local actors from both north and south to develop local solutions to water and sanitation challenges. The Global Water Solidarity Platform, supported by France and Switzerland, aims to connect local authorities and organisations to take action. This would, for example, enable municipal water authorities in more developed countries to take direct action to support the improvement of water and sanitation services in developing contexts by contributing 1% of their revenue or budgets. ● (See IWA News, p64)

Water and sanitation index for Africa

The African Development Bank (AfDB) has created a Water and Sanitation Index of Development Effectiveness (WIDE) that has been used to show that more Africans have access to clean, safe water but that progress has been mixed across the continent.

In a recent economic brief the AfDB noted that overall access to improved water sources had rised to 60% by 2008 compared to 49% in 1990, equating to a marginal increase of less than 1% per year. Growth in access to sanitation was more disappointing, the report said, increasing to just 31% from 27% over the same period.

The WIDE index highlighted considerable differences between sub-Saharan countries, covering only 45 of the 48 states as reliable data was not available for the Seychelles, Djibouti and Somalia.

Angola came out top on the WIDE scale, followed by Rwanda, Zimbabwe, the Central African Republic and Malawi. Worst was Equatorial Guinea, preceded by Madagascar, Gabon, the Republic of Congo and Tanzania.

The report explains that Angola's success is due to 'the government's implementation of an aggressive capital investment programme to expand and rehabilitate [the water and sanitation] infrastructure' together with institutional reforms put in place after the lengthy civil conflict.

Of the MDG deadline, the report says that though there will be a shortfall in many areas, better monitoring of progress and better understanding of the linkages of aid effectiveness would make an important contribution to their overall achievement.●

OECD report warns of poor agricultural progress on water

A new Organisation for Economic Co-operation and Development (OECD) report warns that governments within the organisation have made little overall progress in reducing agricultural contamination of water over the past decade. Not only are pollutant levels high in many areas, but sources of contamination are also often spread widely across the terrain making measurement and control difficult, it adds.

The overall economic, environmental and social costs of agricultural water pollution across OECD countries are likely to exceed billions of dollars per year, the report warns.

Putting this in perspective, the report adds that for most countries drinking water quality is high with limited health risks, and agriculture is only one source of pollution.

The report contains a number of central messages, including that the key challenge for policymakers in addressing water quality issues in agriculture is reducing farm contaminants lost into water systems while encouraging agriculture to generate or conserve benefits associated with water systems.

The report also says that the impact of agriculture on water quality is either stable or deteriorating, and that agriculture is often the main source of water pollution. Achieving further reductions will be a challenge, especially as most agricultural water pollution is from diffuse sources.

Even when low-pollution management systems have been adopted, the report warns that there is sometimes a considerable time lag before water quality improves.

Based on an assessment of recent OECD country experiences, it notes that policies have generally fallen short of requirements to meet water quality policy goals in agriculture. Recommendations include using a mix of policy instruments to address water pollution, which the report says is likely to outperform a single instrument such as a pollution tax. Compliance with existing water quality regulations and standards must be enforced.

Perverse support should be removed, the polluter pays principle should be taken into account, and realistic water policy targets should be set, the report adds. ●

in brief

● **Engineering companies DHV AND ROYAL HASKONING have announced their intention to merge. The new company will be one of the top 10 independently-owned, non-listed companies and in the top 40 overall. The intended name of the new company is Royal Haskoning DHV, and a request for continuation of the Royal designation will be submitted. The companies note that the move 'accelerates their strategies for international expansion with combined knowledge and geographic bases in Europe, South Africa, Middle East and Asia. The new company will be a significant global player in the maritime, water and delta technology markets and a major party in aviation, mobility and infrastructure'.**

● The **Queensland Floods Commission of Inquiry** report into last year's flooding of the city of Brisbane, Australia, and the surrounding area, which killed 35 people and damaged or destroyed 30,000 homes and businesses, has concluded that the dam operator, Seqwater, breached the protocols in the dam's operating manual and used the wrong water release strategy in the run-up to the flooding. The commission made 177 recommendations including revising the dam's operating manual, improved flood plain management plans, and better public access to flood information. The Water Services Association of Australia responded to the findings in a statement that said the management of South East Queensland dams significantly mitigated the impacts of the flooding.

● **UK water utility THAMES WATER has signed a joint agreement with the Met Office, the UK's National Weather Service, to launch a suite of weather intelligence models for the water industry. The new models combine the Met Office's forecasting expertise and Thames Water's industry know how to help companies better anticipate the effect of the weather across their distribution networks. Meanwhile, seven water companies in the south east of England announced in March that customer restrictions such as hosepipe bans will come into force this year, some as early as 5 April. In its drought prospects report for 2012, issued in March, the UK Environment Agency warned that East Anglia and the south east of England were already in drought after two successive winters with little rain.**

● The Europe & West Asia Regional Awards winners of the **2012 IWA Project Innovation Awards** have been announced. Winner in the Applied Research category was PWN Technologies of The Netherlands for its Demoplant Andijk III. Winner in the Design catetory was Solvay for Project RIPPLE: wastewater minimization with environmental benefits, India. The Operations and Management winner was MACS, Germany, and Batumi Tskali, Georgia, for the Batumi Tskali BelleG billing system for the municipal water utility Batumi Tskali. Spain's CETaqua won in the Planning category for its Water Change work. Winner in the Small Projects category was Aquas de Murcia, Spain, for its SANATUB innovative pipe self-cleaning system. Finally, the Marketing and Communications category was won by Vienna Waterworks for the Favoriten Water Park. Honour Awards were also awarded in each of the categories. More details can be found at www.iwa-pia.org.

● **Moody's Investor Services recently issued a special comment on the UK WATER INDUSTRY that warned regulator Ofwat's proposed changes to the way price limits are set and the UK government's plans to introduce an increased level of competition to the industry could potentially increase credit risk in the UK water sector. Ofwat is consulting on several possible significant changes to the regulatory framework including more direct incentives for water companies.**

Messages and momentum for Rio+20

As the 'Rio+20' UN Conference on Sustainable Development meeting marking the 20th anniversary of the 1992 Rio Earth Summit approaches, the messages coming out of key synthesis reports such as the UN World Water Development Report and the OECD's Outlook to 2050 make clear that there is more of a need for action on water than ever. The hope is that the world's leaders will, indeed, lead.

Perhaps the strongest message being put forward is to emphasise the extent to which water underpins so much human activity, and of course the natural environment upon which we depend. If there is inadequate action on water, there won't be sufficient progress on the other development goals that Rio+20 will address.

Directly related to this, there is a need for more comprehensive management of water, including recognition of the global linkages relating to water. There is a message that the water sector does exist, but that water as an issue goes beyond this. Integrated water resources management remains as a fundamental principle, but the world is just starting to turn this into a reality. Hence the momentum around the core water-energy-food-climate nexus: and perhaps the biggest contribution of March's World Water Forum has been to stimulate greater exchanges between the major actors involved.

Meanwhile, in the more focused area of water supply and sanitation, the Millennium Development Goals have provided impetus for action, but more is needed – not just on sanitation, but on water supply too, where ambitions need to be extended to ensuring supplies are safe, and progress on both needs to be built on the now-recognised human right to safe water and adequate sanitation.

So as the World Water Development Report notes, not only is it up to countries to act, they are also in a position to do so through mechanisms that are in place.

Keith Hayward, Editor

ANALYSIS

Global progress on supply

● Confirmation of progress on water supply leaves questions over issues such as safety, writes **LIS STEDMAN**.

While the news that the water supply Millennium Development Goal has been met is being rightly welcomed around the world, there are some caveats, and data disaggregation reveals that considerable differences exist between urban and rural dwellers, and between rich and poor.

For example, the 'proxy indicator' of access to an improved water source does not provide a complete picture. As the report notes in its introduction: 'However, some of these sources may not be adequately maintained and therefore may not actually provide "safe" drinking water. As a result, it is likely that the number of people using safe water supplies has been over-estimated.'

The report also points out that over 780 million people remain unserved. However, it adds that 'the last two decades have seen impressive increases in the use of both piped connections to a dwelling, plot or yard and other improved sources, such as protected dug wells, boreholes, rainwater collection and standpipes'.

India and China represent a major part of the MDG success story, and if developing countries alone are considered, China and India represent more than half of the people who have gained access – though as the report notes, this is not surprising as they are home to 46% of the developing world's population.

Wide variations are found in the rate at which regions have improved coverage – generally, in regions where coverage was already high more modest gains have been made. Eastern Asia made the most impressive gain, adding 23%, with a small decline in coverage in the Caucasus, Central Asia and Oceania.

The report also unpicks data and looks at trends. One of these is that two clear groupings emerge, the first being a set of regions including sub-Saharan Africa, Oceania, Southern Asia and South-Eastern Asia, where the use of piped water to a dwelling, plot or yard is low, at 30% or less.

Progress in these regions is mostly in the 'other improved category – the report specifically notes that 65% of the population in Southern Asia are using other improved sources rather than piped water.

The second group is Eastern Asia, Northern Africa, Western Asia and Latin America and the Caribbean, where at least 70% of the population are using piped water on premises. Eastern Asia, which is dominated by China, has seen a dramatic increase in piped water supplies since 1990, gaining 35% in 20 years.

The Joint Monitoring Programme also developed an alternative indicator to account for the fact that the poorest countries are often characterised by low baseline coverage and high population growth, which means that despite significant progress they can be persistently off track. ●

Key messages from the World Water Development Report

● **KEITH HAYWARD** looks at some of the key messages from the latest edition of the UN's World Water Development Report.

Every three years, the input of the UN system is gathered together in the UN World Water Development Report to provide a global view of water – the issues, concerns and potential responses. The latest edition, the fourth in the series, runs to three volumes, over 50 chapters, and almost 900 pages.

'The report covers some 100 messages altogether, out of which we identified five key messages,' commented Olcay Unver, Coordinator of the UN World Water Assessment Programme, about the latest edition of the report.

Speaking at the World Water Forum in Marseille, France, in March, he continued: 'The first message is about the centrality of water – the fact that water underpins all aspects of development and the fact that it is the only medium through which the many crises which are taking place can be jointly addressed.'

This means that water should not be regarded as a sector. The report acknowledges that there is a water sector, but argues that it should be seen as more than this. This means in particular acknowledging water's role and relationship in the areas of agriculture, energy, direct human use, ecosystem needs, water-related hazards and sustainable development. Hence the second key point that Unver identified: 'Message number two tells us that gains in one sector can result in declines in other sectors, which is a call for increased cross-sectoral coordination over water issues.'

This latest assessment is subtitled 'Managing water under uncertainty and risk'. As such, a large part of it sets out needs and options for tackling water issues in the future in a way that makes clear how these approaches must be shaped by thinking on uncertainty and risk. In this context, the third message of the report highlighted by Unver relates to the governance of water. 'The report advocates governance reforms to develop flexible institutions that can adapt to change, and as such it advises an adaptive management approach to governance,' he said.

The report sets out a case for what is described as 'a pragmatic proactive adaptive management approach, featuring in particular the use of future scenarios to help shape decisions on what 'no regrets' actions to pursue.

According to Unver, the fourth message of the report relates to the fact that water has largely been considered as a relatively local issue, with a focus on the highest level management being at the river basin level. '[The report] establishes the links between the local and global and observes the fact that global inter-dependencies will be more and more through water resources and various uses of water,' said Unver, explaining that

the result will be increased competition and potentially conflicts if sectors and regions fail to take this into account.

Climate change is one of the issues that brings an international dimension to water management, as well of course as transboundary river basins. On top of this there is the continued rise in global trade, with the associated issue of 'virtual water', and the report raises the additional issue of equity as a global dimension.

Continuing on from this, the fifth main message that Unver highlighed is about implementation and action. This message was directed in particular at national governments which, he noted, 'are also responsible for driving global policy tracks such as those on climate change, sustainable development or poverty eradication as well as implementing these policies.'

And this comment is echoed in the report itself by the statement: 'It is therefore up to the different member states themselves to take leadership and ensure that water is put on the agenda at these processes.' ●

A more water-efficient Europe

● The European Environment Agency's report on a water-efficient Europe is a contribution to a wider blueprint for the region. **LIS STEDMAN** reports.

The EEA's new report on efficient use of water resources in Europe notes that although water quality has improved in recent years, resources are over-exploited in many areas. Together with continued water quality issues and hydromorphological changes, this has had heavy impacts on the status of Europe's water bodies.

Agriculture is one sector where easy efficiency gains are possible, the report notes. Some estimates suggest that around a quarter of water abstracted for irrigation in Europe could be saved just by changing the type of pipe or channel used. Moves to drip irrigation, changed crop patterns and wastewater reuse are particularly promising, it adds.

The report also says that public water supplies could be made more effective, because as much as 50% of drinking water is lost in some EU member states. Resource-efficiency measures in the urban and industrial areas often offer win-win situations, it adds, as technologies that cut water use often also help to reduce energy use, although it notes the energy requirements associated with desalination.

Authorities should set clear environmental targets for water use within the limit of what is sustainable, the report says.

Some kind of 'decoupling' is needed so that increasing economic productivity does not entail increasing water use and increasing environmental impacts, it adds. This should have a dual focus, on resource-efficiency innovations and instruments, and on environmental sustainability boundaries.

The report also observes that historically, water prices in Europe have rarely reflected the true financial cost of supplying water, or the economic costs to the environment. This has led to pollution and water scarcity, imposing costs on the environment and society.

For example, the general public typically has to pay for the cost of treating drinking water contaminated by agriculture or industry, the report notes. Putting the right price on water can incentivise more efficient use of water and technological innovation. Effective use of taxes and other economic instruments can also help balance conflicting demands on water, the report adds.

Report chapters look at issues such as water-resource efficiency measures and tools, use of markets, and improved information. Water saving devices, metering, greywater reuse, rainwater harvesting and leakage reduction are seen as the most important technical measures available.

Later this year, the EC's Blueprint to safeguard Europe's waters will be published, which will map the way forward in this area. The efficiency report is the first of five related EEA reports of 2012 to provide policy-relevant information for the Blueprint. ●

Meeting the challenges of the water-energy nexus: the role of reuse and wastewater treatment

● Water and energy are intertwined, with energy required for water treatment, and water required for energy production, so reusing wastewater and closing water and energy cycles is one way to address reducing resources. **VALENTINA LAZAROVA, KWANG-HO CHOO** and **PETER CORNEL** explain how exploring further the reuse potential of wastewater is key to future urban living.

The Sun is the source of all energy on Earth, and water is the basis of all life on our planet. The relationship between these vital media only becomes clear on closer inspection: energy from solar radiation fuels the natural water cycle. Gigantic quantities of seawater are desalinated by evaporation and transported as clouds, returning to earth as freshwater precipitation. Without the input of energy from the sun, the entire water cycle would quickly come to a standstill.

When water experts talk about the nexus of water and energy they do not usually include these natural global processes, without which life on Earth would not be possible. It is because of this common omission that, within the last decade, the terms 'water footprint' and 'virtual water' have aroused more and more interest. However, in general, the technical processes used for energy conversion require water, while water use requires energy. Even at this level, the nexus of water and energy is inextricable, and the link between the two is stronger than might appear at first sight.

Directly and indirectly, water is essential for the conversion of energy. Water is used to generate electricity by hydropower, wave or tidal power. Huge quantities of water are needed to explore and extract fossil fuels and for power plants, which use steam to drive turbines and cooling water to dissipate heat. In addition, the cultivation of energy crops for biogas and biofuel production also requires water.

There is also manifold use of energy in the water cycle: energy is required for water and wastewater distribution, usage and treatment, with households requiring the largest share. On the other hand water and wastewater contain energy in several forms, which can be used in generating electricity and heat.

To sum up: energy is needed for water cycle management, water is needed for energy production and water reuse can help to save both. As with water reuse, the unlocking and enhanced reuse of the energy contained in wastewater is a key tool in solving the water-energy nexus that urbanised centres face worldwide.

The water-energy nexus

Solving the water-energy nexus to preserve our environment is undoubtedly the challenge of this century. Population growth and increasing living standards have depleted resources and caused biodiversity losses, and even climate change. It is therefore vital to revise our models of development, especially in terms of holistic management of water and energy.

The traditional linear approach to water management often does not recognise or understand, as it should, the interactions between water and energy. With increasing water scarcity and soaring energy costs, the strong links between water and energy are becoming increasingly obvious. The effects of global warming and climate change reinforce the need for a holistic approach to managing energy and water – along with nutrients – in an integrated system that fits with growing urban development.

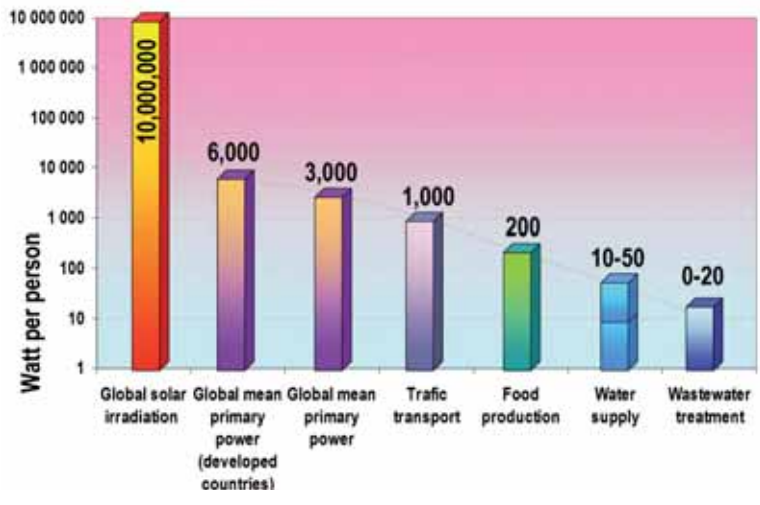

Figure 1: Global primary power consumption and power for water supply and wastewater treatment (adapted from Kroiss and Svardal, 2011).

Energy for life

The total solar power supply to the earth is in the range of 10 million Watts per person (W/cap), most of which is driving the global natural fresh water cycle (Kroiss and Svardal, 2011). However, solar irradiation and fresh water availability are extremely variable over time and region, and population growth is often not adequately matched by water or energy availability.

As illustrated in Figure 1 the current mean global primary power consumption is about 3000 W/cap, and up to 6000 W/cap for developed countries. Some 1000 W/cap of energy consumption is used for transportation and almost 200 W/cap for food production. By comparison, the water supply uses 10 to 50 W/cap, while highly efficient biological nutrient removal wastewater treatment plants need a power input of between 0 and 20 W/cap. Pumping energy requirements for water systems and energy requirements for wastewater polishing before recycling strongly vary depending on the specific local situation, but are in the same order of magnitude.

Energy for water

The energy required to convey and treat water to acceptable levels is in the range of 0.05 to 5 kWh/m^3, depending on the water source (freshwater, seawater or wastewater) and specific regional parameters such as climate, water availability, water use and population density. The typical specific energy consumption of the major elements of the urban water cycle and treatment processes is shown in Figure 2 (Wilson, 2009; Meda and

Cornel, 2010;Voutchov, 2010).

Water and wastewater treatment facilities' energy consumption varies across a similar range from 0.2 to 1.4-1.5 kWh/m³ depending on the pumping head, level of treatment and plant capacity. Water conveyance can reach values of 1.1 kWh/m³ and may have a significantly higher energy footprint in specific cases, such as long-distance transportation: for instance, the State Water Project in California, for example, uses 2.5 kWh/m³.

Advanced wastewater treatment for nutrient removal and water reuse requires more energy. Nevertheless, water reuse is one of the most cost and energy efficient alternative water resources compared to desalination and long distance water transportation. Energy efficient advanced water recycling plants such as the Groundwater Replenishment System (GWRS) project in Orange County, California, are producing recycled water of drinking water quality with a relatively low energy footprint of 0.53 kWh/m³ (Mehul, 2010). Comparing this to one of the most energy efficient desalination plants, Ashkelon in Israel, which has an energy consumption of 2.9 kWh/m³ (Voutchkov, 2010) and a similar treatment capacity (265,000 m³/d and 330,000 m³/d, respectively), the energy footprint of advanced water reuse is 5.5 times lower.

Energy optimised nutrient removal with anaerobic digestion, as found for example at the Strass wastewater treatment plant in Austria (220,000 people equivalent (PE)), not only has a relatively low energy footprint of 0.35 kWh/m³ but also produces electricity, achieving energy self-sufficiency (Novak et al., 2011).

Until recently, seawater desalination was limited to regions with a predominantly desert climate. The latest technological advances and an associated decrease in water production costs and energy demand have expanded the technology's use to coastal areas traditionally supplied with fresh water resources. Desalination's energy consumption is still higher than other water supply alternatives, but the implementation of high efficiency reverse osmosis (RO) membranes and energy recovery devices has enabled the specific energy consumption to be reduced to 2.5-2.8 kWh/m³ at large desalination plants, and cut annualised specific costs.

Globally, rainwater harvesting (RWH) technologies are becoming increasingly popular as the desire for buildings to become more adaptable and resilient to climate change and population growth increases. It is important to stress, however, that the majority of RWH systems use pumping equipment and schemes characterised by high energy consumption, typically in the range of 0.3-1.2 kWh/m³ with a significant carbon footprint. It should however be noted that the majority of rainwater harvesting systems are at small scale, being used for individual or high-rise buildings, so a direct comparison with large facilities is not appropriate. Innovative gravity-driven RWH systems, recovering kinetic energy from the water flow or using solar energy, may help reduce energy consumption and improve the sustainability of rainwater harvesting.

Figure 2: Typical energy footprint of the major elements and processes in water cycle management (Adapted from Meda and Cornel, 2010, Wilson, 2009, Voutchkov, 2010 and Lazarova et al, 2012).

Water for energy

The water footprint of energy (that is, the volume of freshwater used in energy production) is not well documented and understood. Nevertheless, in the framework of sustainable development, the water footprint of conventional and renewable energy sources is becoming one of the major criteria for assessing their sustainability. Water is a crucial component in producing power and renewable energy (such as geothermal power, heat pumps, osmotic power and bio-ethanol). With the growing interest in renewable bioenergy its high water demand presents another challenge, particularly in conditions of water scarcity.

As shown in Figure 3, the water footprint of fossil fuels is relatively low, in the order of 0.38 to 0.72 m³/MWh energy for gas, nuclear and coal (Gleick, 1994). The water used by power plants for driving turbines and cooling is similar, around 1 to 3 m³/MWh. Nevertheless, the significance of this water requirement was highlighted during the European 'hundred-year summer' in 2003, when numerous power plants were forced to reduce their output or even shut down because there was insufficient cooling water available.

The water footprint of hydropower is much higher than other conventional energy sources, at up to 250 m³/MWh, equivalent to 6 8m³/GJ (Mekinnen and Hoekstra, 2011). The shift towards bioenergy requires more water, up to 600 and 1130 m³/MWh for biogas and biodiesel from crops respectively (Gerbens-Leenes et al., 2009). Depending on the methods and types of substrate used, the water demand is between 68 and 443 m³/MWh for biogas production, between 144 and 1440 m³/MWh for bio-ethanol production, and between 360 and 2160 m³/MWh for biodiesel production. Even in regions with a comparatively large rainfall, irrigation water might be needed to cultivate energy crops.

An important factor for water consumption in energy production is the quality and availability of used water. Some processes pollute water more than others, and in different ways. For example, cooling towers mostly change the temperature of the water, whereas the water used for coal extraction or plant operation (ash handling or flue-gas desulphurisation process make-up water) might be contaminated with suspended solids, acids or heavy metals. In terms of availability, evaporation should be assessed. In addition, water for cultivating crops is no longer directly available once used, in contrast to water from one-pass cooling systems.

The most water efficient way to generate bioenergy is to use total biomass, including the parts without an economic value, to generate heat. Generating electricity is the second best option. In principle, generating energy from already available residues, for instance from the food industry, should have priority over the production of energy crops, because the water demand is not the only major factor – further influences on the ecosystem can be considered, such as deforestation to gain further cultivated areas, desertification and nitrate input.

Solving the water-energy nexus

Integrated resource management in the Cities of the Future or eco-cities represents a major paradigm shift in the way new cities will be built or older ones retrofitted. The aim is to achieve a change from the current unsustainable status to sustainability, meet the net zero greenhouse emission targets, and reuse and recycle water and recover resources, including nutrients (Novotny et al., 2010). A closed urban water-energy cycle can be achieved through a holistic approach of water management combined with heat and energy recovery.

Decentralised or semi-centralised water distribution systems will be more efficient for future cities when water reuse is inevitably considered (Bieker et al., 2010). Water supplies can be tailored to match demand more closely in centralised water infrastructures, adapting water quality to the given use. With substituting fresh water with appropriately treated recycled water, it is possible to save 30-50% of domestic water demand. The implementation of the semi-centralised approach to urban infrastructures would not only allow substantial water and energy saving, but would also provide new opportunities for energy recovery from biowaste throughout biogas production and for the use of nutrients in sewage sludge to produce biosolids for agriculture and other uses.

It is important to stress that alternative water resources are not in competition with each other or with conventional water supply sources. They should instead be considered as essential components of an integrated water management portfolio that balances their use depending on local conditions to improve water and energy management and efficiency and secure a reliable and sustainable long-term water supply. The synergies between desalination and water reuse have to be strengthened as there should be an incentive to keep desalinated water in the water use loop as long as possible, minimising freshwater discharges to the sea. In the Cities of the Future, all water resources, including rainwater and seawater, if available, should be considered in solving the water-energy nexus.

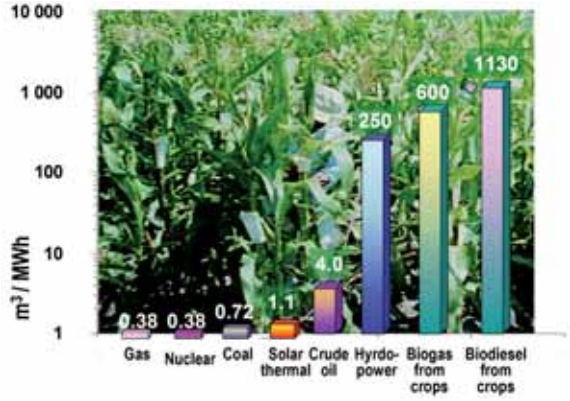

Figure 3: Water footprint of energy production (Adapted from Gleik, 1994, Gerbens-Leenes et al, 2009 and Meconnen and Hoekstra, 2011).

Sustainability in water resource planning requires consideration of the embodied energy in the water cycle, and in water recycling in particular (Wilson, 2009; Meda and Cornel, 2010). Water reuse enables energy use within the water cycle to be optimised, particularly within decentralised and semi-autonomous urban systems, and at a treatment level that adheres to the 'fit for purpose' principle. Recycled water needs to be delivered at a cost that is justified by its purpose, so energy-intensive processes should be limited unless exceptionally high water quality is required.

It is important to stress that the value of recycled water includes the embodied energy that is reclaimed from the water cycle. When the capital and operational costs of embodied energy in recycled water are accounted for, the overwhelming savings from operational energy recovery substantially offset the costs of water reuse infrastructure (Wilson, 2009). Reclaiming treated wastewater promotes environmental benefits by ensuring better water quality and optimising energy use within the water cycle. Water conservation, while an important component of a sustainable water resources management plan, does not provide the same value chain impact in terms of reclaiming the energy already embodied in the water product.

For alternative water resources, choosing the best option for water management means developing and applying a multi-criteria analysis, or the triple bottom line approach, based on economic, environmental and social impacts.

Toward energy-positive wastewater treatment

Wastewater treatment plants have the potential to become environmental platforms, and to provide an energy source for tomorrow's eco-cities as part of a system characterised by the smallest possible ecological footprint (GWRC, 2011).

It is important to stress that energy self-sufficiency for wastewater treatment facilities cannot be considered as an objective in itself, but as a component of a global water management strategy that takes into consideration regional and local specifics as well as environmental, social, and economic issues. Improving wastewater treatment performance is and should be the primary objective, followed by choosing the best available practices and technologies for enhanced energy efficiency and the best use of sludge for energy production and recovery. To be more attractive, innovative technologies for energy recovery must be cost-effective, reliable, easy to operate and should have no adverse impacts on water quality or the environment.

An analysis of current practices shows that energy self-sufficiency for wastewater treatment is a feasible goal. However, for existing plants this requires a long optimisation process, relatively high levels of investment and the use of innovative technologies in new, more energy-efficient facilities (GWRC, 2011; Svardal and Kroiss, 2011).

Figure 4: Left: Strass WWTP in Austria (Credit: Bernhard Wett) Right: As Samra WWTP, Jordan (Credit: Degremont)

Robust benchmarking programmes and guidelines for energy optimisation have been implemented in Europe since the early 1990s (Austria, France, Germany, Switzerland and Sweden), demonstrating a considerable potential for energy optimisation in existing plants of between 20 and 50% (Lindtner et al., 2008; Wett et al., 2007). Similar energy reduction programmes have been launched in Australia, the US and Canada (WERF, 2010). As a result, several wastewater treatment plants in Europe have achieved the goals of high energy efficiency and energy self-sufficiency.

Today, two municipal wastewater treatment plants in Austria are energy self-sufficient – the 220,000 PE Strass plant, (Figure 4a) and the 50,000 PE Wolfgangsee-Ischl plant (Wett et al., 2007; Novak et al, 2011) and there are a number of other ongoing projects. Both of the Austrian energy-self sufficient plants have activated sludge processes with nutrient removal (with less than 1mg total phosphorus/l, and over 80% nitrogen removal) and energy optimisation over a period of around 20 years. The key energy optimisation measures for these two plants include optimal aeration control, higher recovery of particulate carbon from the primary settlers to provide more organic matter for anaerobic digestion, optimised mesophilic anaerobic sludge digesters, energy efficient combined heat and power (CHP) units, and use of the DEMON-process for deammonification of the sludge dewatering filtrate (Novak et al., 2011).

Very little information is reported in the literature on the design and operation of new energy sufficient wastewater treatment plants. The As Samra plant in Jordan (Figure 4) is a very good example, achieving a target of over 90% of self-sufficiency in energy since its commissioning in 2008 (Fievez, 2009). This new 2.2 million PE capacity facility treats 267,000m^3/d of wastewater for the inhabitants of Amman and the surrounding areas, producing a quality effluent for reuse in agriculture.

The plant has an activated sludge process with nitrogen removal and disinfection using chlorine, odour treatment and anaerobic digestion of the mixed sludge. The energy demand for this plant (85% to 95%) is met by next-generation technologies such as hydraulic turbines and biogas-driven cogeneration. The mean energy consumption per population equivalent is 21.3 kWh/pe$_{110}$yr (the population equivalent related to 110 gCOD/PE.d with a mean COD/BOD5 ratio of 1.87). This value is slightly higher than the Strass WWTP's energy consumption, which is 19.9 kWh/PE.year (Novak et al, 2011), but the As Samra plant also has disinfection and odour treatment facilities.

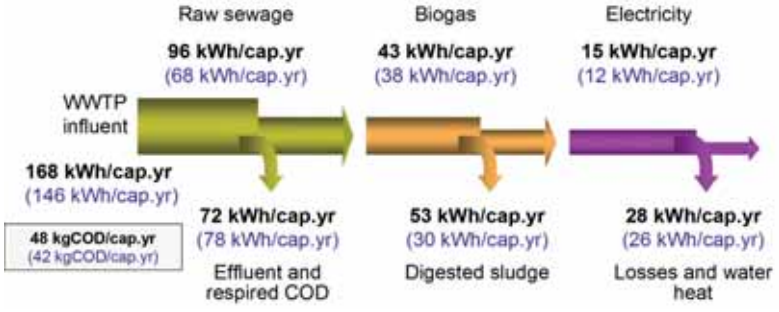

Figure 5: Energy COD balance schematic for typical wastewater treatment plants (adapted from Cornel et al, 2011 and Lazarova et al, 2012).

Energy recovery from sewage flows in the As Samra plant aims to recover the potential (kinetic) energy embodied in wastewater. However, the energy yield of this energy source is relatively limited and depends on local conditions, particularly elevation difference and flows. Chemically-bound energy from the organic matter in wastewater has the highest potential for recovery (Meda and Cornel, 2010). Here, the energy balance depends on the organic concentration of the wastewater, on

IWA World Congress on Water, Climate and Energy

The inaugural IWA World Congress on Water, Climate and Energy will be held from 13 to 18 May in Dublin, Ireland. Over 1000 delegates, professionals in these three key, interlinked areas, will meet to discuss the state-of-the-art and debate key issues.

Ray Earle, the congress chair, explains that this is a groundbreaking event: 'This is the very first time that we have brought these three important issues together. We have had a lot of single and some bilateral events on the water-energy nexus, but this is the first time we are looking at water, energy and climate change.'

A whole set of disciplines have to come together, he notes, ranging from researchers to businesses, think tanks, developers, agricultural concerns, constructors, retailers, and the service sector, among others.

'This is the first time we have looked at these issues in a holistic way,' Mr Earle adds. He sees the need for joined-up thinking on these three vital areas, to create policy and advocacy, which is one of IWA's key roles.

'The real driver is literally survival,' he notes. 'The financial and environmental crises go hand in hand. The UN says that the world will double its population by 2050, with the pressures that will bring for water and sanitation, and at the same time climate change will be bringing natural disasters.'

He observes that these issues are fundamental – energy is ultimately from the sun and water from rain. 'It is about getting back in harmony with nature, how do we get more efficient, cleaner and more sustainable going forward – and we have to do it now.'

This is the main theme of the conference, he explains, warning that the current path being taken is unsustainable. 'We are using resources that we are borrowing, that we should have left for future generations.'

To reverse the current levels of over-consumption we have to look at how to harness solar energy, hydroelectricity and wind power in a clean, efficient and sustainable way, he adds, across the entire process of generation, storage and transmission, and using this green energy to move water around and provide the power required for sanitation.

Mr Earle warns: 'We won't survive unless we look at the requirements of the food chain and ecosystems and all the requirements for water and energy. If we don't get joined up thinking all of the protocols will remain dysfunctional, there will be more mortality, we will lose the food chain we depend on and there will be more natural disasters. We have got to get back to soft engineering and natural solutions.'


Ray Earle

This event, he explains, is invaluable. 'It has to happen now. It is absolutely a crisis situation – economically, environmentally and in terms of sustainability.' It will be important to plan strategically for climate change, he notes, and to account for its consequences – for instance, the potential property and environmental impacts of flooding.

He adds that both adaptation and mitigation need to be addressed, noting: 'We want a very strong declaration from the congress, so that the IWA can play a strong advocacy role for future congresses and decision-makers.' **By Lis Stedman**

For more information, visit: **http://iwa-wcedublin.org**

the country's specific per capita water consumption, the type of sewers, the percentage and type of industrial effluents and other local conditions.

Figure 5 illustrates two example energy balances (Cornel et al., 2011; Lazarova et al., 2012). In both cases the treatment processes are the same, including primary settling, nitrification / denitrification, anaerobic sludge stabilisation and use of biogas. The main assumptions are the COD loads of 48 and 42 kg/cap.yr, methane production of 0.35 l CH_4/gCOD and a methane energy potential of 10 kWh/m^3. Despite the slightly more concentrated wastewater in the first instance, the energy balance is quite similar: 57% (96kWh/cap.year) is transferred to the digester and only 26% (43 kWh/cap.yr) is transferred into methane. Using the same conversion efficiency of 32%, only 8.9% of the embodied chemical energy is recovered as electricity (15 kWh/cap.yr).

The most promising technology for recovering the chemically-bound energy in wastewater is still anaerobic digestion. Emerging energy-efficient and energy-producing technologies, such as microbial fuel cells, microbial electrolysis cells and microbial desalination cells, are expected to be feasible in the near future.

Maximising the energy gain from each of the potential sources of energy savings and generation (see box) would allow wastewater treatment plants, particularly the largest ones, to recover and eventually to generate all of the energy needed for plant operation, and even yield an energy surplus at times.

While in its infancy at present, sustainable wastewater treatment and reuse have come of age and are likely to gain greater importance in the planning of integrated water and energy management systems in the future. As with water reuse, the unlocking and enhanced reuse of the energy contained in wastewater is a key tool in solving the water-energy nexus that urban centres face worldwide.

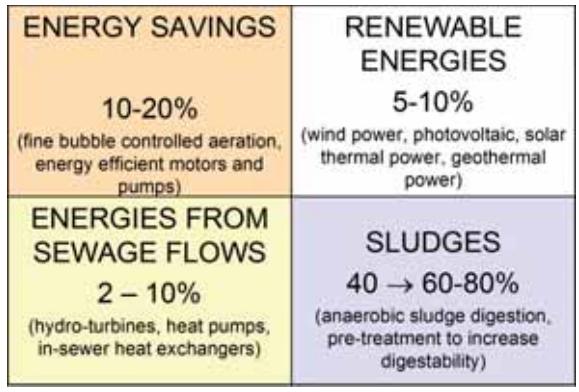

Figure 6: Major components of the 'positive energy plant' – zones where the energy efficiency of wastewater treatment can be improved.

Gaining energy from wastewater treatment

Optimising the energy of a given wastewater treatment plant will require a global analysis of the wastewater treatment train in terms of the current water quality requirements and the best integration of the energy issues. The aim is threefold: to improve energy efficiency, to maximise the use of sludge for energy production, and to recover energy from internal or external sources. Four main components for design and operation of a 'positive energy plant' (that is, a plant that produces more energy than it uses) have been identified (Figure 6, Lazarova et al, 2012):

Energy savings from implementing technologies and best practices for low energy consumption (up to 20% energy recovery):

- Use of best available energy management practices, such as optimisation of aeration system design, efficient aeration control, and use of premium efficiency motors and variable frequency drives for large pumps and aeration devices (such as blowers and mechanical aerators)
- Innovative waste stream handling technologies, such as sidestream treatment of the concentrated return flow from anaerobic digestion by deammonification to reduce the energy used in biological wastewater treatment
- Next generation treatment technologies for domestic wastewater or decentralised wastewater treatment and reuse systems

Energy recovery from sludge (up to 60-80% energy recovery):

- Best practices to improve digester design and operation; enhanced primary settling efficiency
- Innovative technologies for sludge pre-treatment before anaerobic digestion; co-digestion
- Combined heat and power generation from digester gas as electricity (cogeneration, fuel cells, microturbines) or mechanical energy (direct drive or stirling engines), gasification
- Direct reuse of biogas after purification to the gas grid
- Use of biosolids in agriculture or as a solid fuel

Energy recovery from sewage flows – thermal, hydraulic, potential (up to 10% energy recovery):

- Use of specific local conditions (topography, location and infrastructure) to recover energy from the plant's influent and / or effluent
- Innovative waste stream energy harvesting technologies such as hydro turbines and heat exchangers

Production of renewable energy from external sources such as solar, wind or geothermal energy (up to 10% energy recovery):

- Use of alternative renewable energy technologies that are feasible for the site-specific climate conditions and financial incentives, which require relatively low initial capital costs and site footprint, and have a short return-on-investment period
- Innovative technologies such as photovoltaic-thermal systems, micro wind turbines and combined waste-to-energy technologies.

Concluding remarks

The current configuration of urban water management systems means that significant quantities of water and energy are consumed and nutrients are inefficiently managed. Historically, water and energy have been managed independently, but in the City of the Future the whole water cycle should be managed in a sustainable way that limits energy consumption and maximises energy recovery.

A fundamental component of sustainable water management lies in proper urban design. This consists of distributed water supplies where multiple water resources, including rainwater harvesting, are collected across the urban area to minimise pumping requirements, and where only a fraction of the water supply is treated to potable standards. At the end of the chain, wastewater treatment includes decentralised and centralised components to optimise energy recovery and water reuse. Wastewater has to be considered not only as a potential alternative water resource for various water reuse purposes, but also as a source of nutrients and organic constituents, which are potential sources of energy.

The potential options for solving the water-energy nexus can be also considered from the point of view of the concept of the urban metabolism, which equates a city to a living system, with assimilating and excreting functions. As in a living body, it is essential to have recycling loops in order to maximise the energy obtained from the inputs (food, energy, water and nutrients) before the toxic residues (pollutants and emerging contaminants) are excreted. Moreover, double loop hybrid systems can be introduced for better source separation, as well as for heat recovery and biogas production.

The Sun is the source of all energy on Earth, and water is the basis of all life on our planet. It is our commitment, as water professionals, researchers and decision makers, to safeguard the main drivers of life on our planet and therefore our civilisation: water and energy. ●

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About the authors

Valentina Lazarova is Senior Project Manager at Suez Environnement.

Kwang-Ho Choo is an Associate Professor at Kyungpook National University, Korea.

Peter Cornel is a Professor at Technische Universitat Darmstadt, Germany.

Small-scale hydro shows promise for remote treatment stations

● A pilot hydropower plant has been installed at a South African reservoir in an effort to determine the energy-generating potential of water supply systems. **BILL McCANN** looks at the opportunities available for small-scale power generation in remote locations.

In late November South Africa took its first practical steps towards tapping the energy potential of water supply systems when it commissioned a pilot hydropower plant at the new Pierre van Ryneveld service reservoir in Tshwane municipality.

The launch came as part of a co-operative research effort between South Africa's Water Research Centre (WRC), the City of Tshwane and a research team from the University of Pretoria (UP). It followed earlier desk studies by the UP team and installation of a test unit at the Queenswood reservoir, also in Tshwane, and marks the beginning of a two-year programme that is expected to see a number of pilot plants of varying capacity installed elsewhere in Tshwane, as well as in the supply systems of Rand Water, eThekwini Metro Water Services and Bloem Water.

WRC is backing the programme with 2 million Rand ($266,000) for research and scientific support. Other project partners will also support with capital and staff time of research and engineering teams.

UP scoping studies and preliminary testing at the Queenswood site began in 2008, providing enough information to highlight the potential of these untapped sources. Outline studies of ten larger locations in Tshwane indicated that up to 10MW might be generated within a supply system that includes 160 reservoirs and over 260 places where pressure relief valves (PRVs) are used to dissipate undue pressure – obvious points to study for possible substitution with turbines.

Pilot installation

Pierre van Ryneveld reservoir was not one of the ten, its selection for the pilot installation based rather on the fact that a new service reservoir was being constructed alongside an existing unit in 2011. These are circular reinforced concrete tanks with concrete slab roofs, both receiving bulk water supply from Rand Water. The pilot generating plant is located on the roof of the original tank which is 32m diameter and 10m high and has a capacity of 7.6Ml.

Static head in the incoming Rand Water bulk supply lifts water in a vertical riser to the rooftop installation where it passes through a 240mm diameter cross-flow mini turbine before discharging under atmospheric pressure into the reservoir. Linked to a synchronous three-phase, 50 hertz, brushless generator and operating under a net head of 16.7m the plant can output 15kW. At the November commissioning the new source immediately took over from the local grid to supply power for site lighting. It is also being used for data monitoring at the site and for the security fencing and alarm systems.

The likelihood must be that most generation from water networks will be applied to that type of usage. The research focus is on small-scale hydro with outputs generally for local on-site use or possibly to supply small isolated communities, although, in the latter case, there might be severe limitations on power output from what would probably be low flow, low head water supply systems.

Even so, in the view of Jay Bhagwan, manager of this pilot study and Director for Water Supply and Waste Management at WRC, such systems applied to the metros in South Africa might generate as much as 26,000 MWh over a year.

And a January Progress Report on the Pierre van Ryneveld project by the UP research team estimates that the ten most favourable reservoirs in the Tshwane system have the potential to generate 10,000,000 kWh annually. That estimate is based too on the assumptions that only half the available static head is used for generation, and that power can be generated for only six hours/day, i.e. an output of just 12.5% of the theoretical maximum. According to these calculations, nine hours of generation and using 75% of available static head would push annual output up to 22,480,000 kWh.

These predictions and possibilities must remain for the longer-term development phase. In the more immediate future the focus is on Pierre van Ryneveld and the numerous other pilot hydro plants to be installed by Tshwane and the several other participating water suppliers. Bloem Water is studying the feasibility of two projects to install cross-flow turbines in connecting pipelines between reservoirs; eThekwini Water and Sanitation Department is believed to have tendered for six mini-hydro sets at reservoirs; Tshwane estimates that at least 8MW can be generated at its ten most favoured reservoir sites and Rand Water is said to have identified a firm hydro generating potential of 16MW amongst the 58 service reservoirs of its various supply systems. It is understood that the 16MW could be developed from just four sites but Rand estimates that a further 50MW may be available from pressure pipelines within the supply and distribution systems.

Potential for lower cost energy

On the whole these estimates of project numbers and possible generated outputs give the impression that only small amounts of electricity will be generated at individual sites, but Jay Bhagwan says the research effort is on generation in general. He points out that Pierre van Ryneveld is not yet utilising the full available flow and pressure and has the potential to be scaled-up.

He adds 'It looks as if some of the Rand Water and possibly the eThekwini sites will be of larger capacity. That could mean outputs that would be fed into the grid in some cases but the focus here is on generation from pressure conduits within supply systems. These pilot

The pilot hydro system at Pierre van Ryneveld reservoir. Credit: Marco van Dijk.

plants will be operational units but they will provide data on financial viability – capital and operating costs of the installations against revenue savings from the generation. Those findings will also be relevant to any larger generating sites but the most important aspect of this is that, where any installation is financially viable, the energy generation can be used to offset the energy consumption in the water supply system and help to keep the tariffs low.'

He explains that energy costs are rising rapidly in South Africa, a trend that will continue in the coming years. Municipalities and water service providers must therefore look for energy efficiencies in their systems and, in his view, must start to think 'outside the box' in doing so.

He believes 'pressure hydro' (his words) is an example of that, offering quick returns from an opportunity waiting to be exploited.

From the operational viewpoint generation at remote storage or treatment sites adds the ability to power instrumentation for remote control and, importantly, for site security facilities such as alarms and site lighting. Cable theft, for copper, and vandalism, especially of solar panels, are major problems.

Benefits for small rural communities look much less certain although Professor Fanie van Vuuren, leader of the UP research team, has suggested that even low flow, low head systems can generate power in the pico (up to 20kW) range, sufficient to charge batteries and cell phones. That would at least improve communications in rural areas.

Marco van Dijk, a senior member of the UP team, says the sites they are looking at in Tshwane will generate in the 1kw to 1MW range. Some of these are in remote locations with no power lines close by but he notes that even a 1kW on-site generator will be sufficient to power the security and instrumentation facilities described above.

Within the WRC-funded project his team is also studying the Bloem Water pipeline possibilities, each of which he says looks capable of generating 300kW.

Data gathered from the pilot plant research will be used as the basis for provision of a guideline for municipalities and water suppliers, assisting them to identify, investigate, design and implement conduit hydropower schemes in their water distribution networks.

That will be a significant benefit, as will the offsets to energy consumption in water supply and the security and telemetry gains at remote sites if the potential is realized.

In the context of electricity supply in South Africa as a whole the impacts will not be significant. There is no shortage of supply in major urban areas where coverage is put at nearly 100%. And, as critics note, the initiative offers little for poor or rural communities where distribution rather than generation is the problem and low potable water flows will generate little electricity.

Conversely the ability to generate an annual 26,000MWh in the metropolitan areas – where it is not needed – would come from an installed capacity of just 3MW at constant generation, or 8MW when generating at nine hours/day – the more realistic scenario.

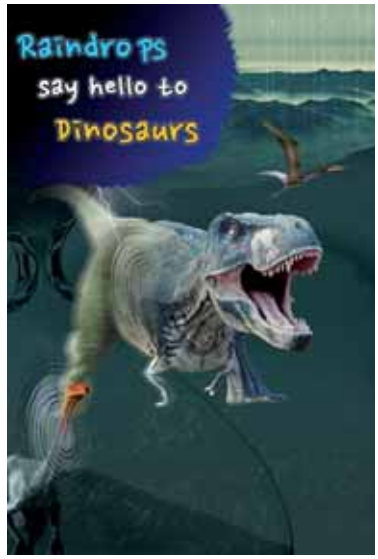
In summary, developments from this research will not add much to the national electricity supply total but can make significant impact on energy consumption by water suppliers and useful contributions to security and monitoring at remote water system facilities. ●

Engaging younger generations in the 'Rain City' concept

The idea of 'Rain Cities' is growing around the world, where rainwater harvesting plays an important part in providing water to growing populations and reducing flood risks. **BRITA FORSSBERG** looks at how an upcoming IWA rainwater harvesting event in Korea, a country which has embraced the Rain City concept, is looking to expand awareness of the benefits of rainwater use amongst younger generations through cooperation with the Dinosaur World Expo, and bringing the opportunities of rain to life.

Integrated water resources management is held in high esteem among water managers, but one water resources – the rain – is often not included in their models. Rain is regarded as an irregular but necessary benefit for agriculture and nature only. In most cities, with predominantly impermeable surfaces, rain is seen as a problem that must be drained away at high investment costs to avoid flooding. However, in cities where climate change and rain variability are taken seriously, really modern water managers act differently and plan for rain to be collected and used efficiently to reduce costly damage and human suffering.

Best practices, ancient wisdom, smart technology and scientific data will be presented in 20-24 May 2012 in Korea when the 3rd IWA RWHM Conference takes place in Goseong County, not far from the 2012 IWA World Water Congress & Exhibition host city Busan, in direct connection with the Dinosaur World Expo. The Expo illustrates the importance of rain for life on our planet and the need to adapt to climatic and environmental changes – through practical rainwater harvesting. Visitors and conference delegates can also enjoy the side events such as a circus, 5D movie theatre, lamp parades, etc., which are arranged for visiting families with children.



The Dinosaur World Expo will explore the wide range of possible uses for rainwater

Science + technology + communications = a necessary alliance for public acceptance

The most notable part of the Goseong event is that the Rainwater Research Centre (RRC) of Seoul National University is cooperating with the organisers of the Dinosaur Expo to communicate RWHM to the visitors, mainly young people accompanied by their parents or teachers. They see it as an investment in the future as it is a well-known fact among communicators that young people, when taught about water, quickly understand the importance of their new knowledge and tell their parents and friends. Catching the direct attention of adults is much more difficult.

The slogan of the Expo inspires the imagination: 'Raindrops say hello to dinosaurs' and the theme of the conference is also eye-catching: 'From Drain City to Rain City by Training Brain Citizens'.

Professor Mooyoung Han, Director of the RRC, Chair of the IWA Specialist Group on Rainwater Harvesting and Management, and initiator of the IWA RWHM Conference, explains: 'Communications is very important! RRC has promoted rainwater management to people in many ways for more than ten years. We have given lectures to key persons in the administration and the government, [and] been interviewed many times in TV, newspapers and magazines in Korea and other countries. Our work is based on the research, the technical solutions and scientific analyses from successful demo projects in several places. Communicating with people makes citizens understand the great importance of rainwater management. That is why we are working together with the Goseong County Governor and the organisers of the Dinosaur Expo.'

Rainwater demo project in Hanoi, Vietnam. Credit: Mooyoung Han.

Dinosaur Expo – a real life RWHM classroom

The purpose of the Dinosaur Expo is not only to let the visitors experience exciting, extinct animals. It is also a full-scale 'rainwater classroom' with practical examples of rainwater harvesting in place all over the premises. It will be easy for the visitors to understand how rainwater can improve the self-sufficiency ratio of water. The drops are collected from clean roofs and pass through fine mesh filters into covered, closed tanks that secure the

water quality. From there they can be enjoyed at drinking water stands spread throughout the building. Public blind testing will be arranged to choose the best tasting water from tap water, rainwater and groundwater. Rainwater will also be collected and used in spectacular fountains, in the waterfalls, for watering plants and all the other daily necessities within the Expo area.

Raindrop pool and Rainwater Museum

There will be rainwater tanks that can be used to supply homes while other installations are adapted to larger buildings and land areas. The swimming pool fills up with rain from the wide, surrounding open spaces and the roofs of the expo halls. Near the pool is the 300m² Rainwater Museum where exiting experiences will make the visitors see that rain is an important resource that must be handled wisely. Movies and digital technology, hands-on experiences and their own creativity will make them understand their own important personal role for water and RWHM, now and in the future.

Climate change adaption through RWHM prevents disasters and saves water and energy

Rainwater harvesting is of particular interest to Korea as is ranked 43 out of 147 water-scarce countries according to the UNESCO water shortage index of 2006. It is also a country occasionally hit by extreme rainfalls during the monsoon season. The precipitation level from July until October has increased considerably since 2000, compared to 30-year rain events. A severe event occurred 27 July 2011 in the capital Seoul where flooding and landslides caused great damage and casualties.

To prevent disasters and facilitate water independence, the Korean Ministry of the Environment recently stipulated the 'Law on Water Reuse Promotion and Support'. The National Emergency Management Agency formulated the 'Law on Countermeasures of Natural Disasters', bringing in decentralised rainwater management. Nearly 60 Korean cities are changing their local rainwater policies from draining to collecting, regulating and using rainwater. They form the new 'Rain Cities' on the initiative and guidance of RRC.

The first and most famous landmark of rainwater management is the 'Star City', a new high-rise building complex in central Seoul, which was a RRC initiative. The savings in water and energy during one year are 40,000m³ and 10,000kWh respectively. Underneath the building are three interconnected rainwater tanks, each with a volume of 1000m³, for flood control, water saving and emergency purposes. One collects stormwater from unpaved local areas. The second tank collects rainwater from the roofs. And the third tank is filled with tap water or groundwater. The system functions well during the typhoon season when heavy rain is expected – if alerted by the Korean Meteorological Agency, the first 1000m³ tank can be pumped empty and contain the next rainfall. It is designed to hold the first 100mm rain. The water in the second tank is used for toilet flushing or irrigation with no treatment other than natural sedimentation. The third tank can be used for emergency purposes such as unexpected failure of the water system or fire-fighting. The project won the IWA Project Innovation Award for the East Asia region for Applied Research in 2010.

There are also small-scale RWHM initiatives where the RRC team cooperates with local authorities and the inhabitants of villages in water-scarce areas to permanently secure clean drinking water after natural disasters or serious droughts such as at Banda Aceh, Indonesia, the Solomon Islands, and Hanoi, Vietnam. The villagers are always involved in constructing and managing their own rainwater system close to where they live. It fills up during the rainy season and provides them with safe drinking water for the rest of the year. By buying the clean water at a low price the inhabitants contribute themselves towards future investment in further tanks, and a healthier, more prosperous future. Without rainwater management they would have to rely on unsafe, irregular water supply or buy drinking water from ambulating water trucks at a cost approaching 20-30% of their income.

Cities of the Future are cities of today – but better

Cities of the Future is one of the 'ideological pillars' of IWA. The theme aims at 'developing new paradigms for highly efficient urban water services in new and existing cities throughout the world. The programme focuses on water security for the world's cities: how the design of cities – and the water management and water services – could be harmonised and re-engineered to minimise the use of scarce natural resources and increase the coverage of water and sanitation in lower and middle income countries.'

Rainwater tank being attached to house. Credit: Mooyoung Han.

Rainwater harvesting fits into this picture. Water management must take the lead and integrate with urban planning to counteract and adapt to the negative effects of climate change and increasing urbanisation by developing and using new approaches, new technology and old wisdom. This is becoming a reality in the Korean Rain Cities and increasingly so in other water cities like Singapore, Seattle, Hamburg, and Stockholm. May others follow in many more countries all over the world! ●

Notes

[1] Funded within the context of the Seventh Framework Programme 'Environment'. It aims to contribute to the Renewed Sustainable Development Strategy of the European Union through the enhancement of the links between sanitation policy and research on sustainable sanitation development.

[2] Comune di Castel S.Angelo di Rieti (CSA) (Municipality of Castel Saint'Angelo of Rieti), Italy, Department of Technology and Society Studies, Research Institute on Arts and Social Sciences, University of Maastricht (UM), Netherlands, International Water Association (IWA), Italian Branch of the Council of European Municipalities and Regions (AICCRE), Italy, Laboratorio di scienze della cittadinanza (LSC) (Laboratory of Citizenship Sciences), Italy, National Council for Research of Italy (CNR), Italy, Pernik Municipality on behalf of the Water Supply and Sanitation (PNK), Bulgaria, Research Centre Regional and Global Development (REGLO), Bulgaria, Water Board Company Limburg (WBL) Netherlands, Water, Engineering and Development Centre, and Loughborough University (WEDC), UK. www.besse-project.info/consortium-partners.

About the author
Brita Forssberg is Secretary of IWA Governing Member Sweden and Chair of the IWA Specialist Group on Public and Customer Communications. Email: brita.forssberg@comhem.se

COVER STORY

Adapting municipal wastewater treatment technologies for wider global use

● The German Federal Ministry of Education and Research has spent around €6 million ($7.9 million) to finance 24 research projects on adapting time-tested technologies to the boundary conditions of other countries and regions. **HERMANN ORTH** and **PETER WULF** discuss a new programme, which began this January, which will validate the results in pilot-scale and full-scale treatment plants.

Various municipal wastewater treatment processes are used worldwide, and the know-how involved is also spread widely around the globe. In national technologies and rules the focus is mainly on optimising details, with research and development in this field still being largely undertaken in the leading industrial nations. This often means that in the course of developing the various technologies, little attention has been paid to boundary conditions not found in these countries. This situation has led to knowledge gaps and, given Germany's great international commitment to the water resources sector, the German Federal Ministry of Education and Research (BMBF) felt itself to be under the obligation to help reduce these deficiencies through a research initiative of its own.

This initiative did not focus on pure research, but on adapting well-known wastewater treatment technologies to specific initial conditions by adapting design rules and planning instruments. A precursor project, on the requirements for wastewater technologies in other countries, was followed by the Joint Project, which consisted of 24 individual projects. These were carried out at 11 universities with the involvement of four companies, and were subdivided under three headings: wastewater treatment; disinfection and water reuse; and planning tools and simulation. The results have been compiled in a manual.

Wastewater treatment

The first three projects under the heading of wastewater treatment dealt with the activated sludge process, the aeration part of that process, and the trickling filter process. Depending on the tasks, reactors with volumes ranging from 7.5 litres to 39m^3 were used for the activated sludge process investigations. A semi-scale trickling filter (with an 18m^3 volume, 3.9m fill level and 2.5m diameter) was built to investigate the trickling filter process. Lava slag and plastic fill materials were tested for suitability. In the various activated sludge process test series, the wastewater temperature varied between 3°C and 30°C. In the trickling filter process, the wastewater temperature and the air temperature were set at 25°C and 30°C respectively.

The results and recommendations were based on a large number of series of tests involving specific test settings. The principal parameters relating to the activated sludge process were sludge age, sludge production and the oxygen mass transfer coefficient k_La_{20} and, for trickling filters, the volumetric loading rate for fill material based on plastic or lava slag. These parameters are correlated to wastewater temperature, which proved to be the primary factor in the adaptations that were required. In addition, instructions are given in the manual on how to adapt the process to high salt concentrations and low carbon / nitrogen ratios. Activated sludge process trials at low wastewater temperatures showed that the nitrifying bacteria in the sessile biomass adapt themselves considerably better than those in the suspended biomass.

In tests of the efficiency and flexibility of rotating biological contactors, the experimental plants were temperature and moisture regulated and run at wastewater temperatures between 20°C and 35°C. A three-cascade experimental facility for a population equivalent of 150, covering a total area of 1350m^2, was set up in India for the purpose of demonstrating and testing the practical operation of the plant. For rotating biological contactors, the significant impact of wastewater temperature and the increase in performance associated with high temperatures were both demonstrated. Consequently, in contrast to existing design recommendations, the manual recommends that the temperature factor should be included at the design stage. Corresponding equations are set out in the text.

Cover image and right: Example of an activated sludge process plant in high-temperature conditions: Fujairah wastewater treatment plant (100,000 PE, UAE). Credit: Emscher Gesellschaft fuer Wassertechnik mbH.

The considerable impact of temperature was also apparent in tests involving immersed fixed bed reactors. However, unlike TKN (total Kjeldahl nitrogen – the sum of organic nitrogen, ammonia and ammonium) degradation, no increase in the surface loading rate at elevated temperatures is suggested for degrading carbon compounds. This is to counter the susceptibility of the packing material to clogging, which increases at higher loads. In the tests involving high salt concentrations, a considerably greater tolerance was observed compared to that found in the activated sludge process trials.

Sanitation / disinfection and wastewater reuse

This area of investigation looked at the recovery of resources from the wastewater treatment process. These resources include water, primarily but not solely for irrigation purposes, the production and utilisation of biogas, and the recovery of biosolids.

Various process chains and operating conditions relating to municipal wastewater reuse were studied at laboratory scale. The main treatment steps were mechanical treatment, biological treatment, filtration and UV disinfection. Finally, tests were performed at a pilot plant in Morocco. The investigations proved that mechanical treatment alone does not produce an effluent quality suitable for any type of reuse. The biological step is only sufficient for some types of water

reuse due to the inadequate disinfection provided. A facility for disinfecting effluent can be added to a properly-functioning biological step, but as a rule a filtration unit placed between these two steps is advantageous.

A container plant with a usable basin volume of 50m^3 was available for industrial-scale trials of anaerobic treatment. Additional trials were carried out in Egypt using semi-scale and industrial-scale plants. The manual stresses that anaerobic treatment is to be regarded as a preliminary stage preceding chemical oxygen demand reduction and that both the biogas produced and the methane dissolved in the effluent are to be taken into account, the latter because of its global warming potential. Again, the increase in performance that occurs as the temperature increases is clearly shown in the explanations of the design procedure. In addition to information on plant construction and operation, the manual explains energy production and the principal factors influencing costs.

Making an allowance for the summer and winter operation of wastewater treatment plants that produce irrigation water enables nutrient removal facilities to be dispensed with during the irrigation period. During and after the irrigation period however, it is necessary to ensure that the nitrifying biomass can either be preserved or rapidly regenerated. The biofilter process is particularly suitable for this purpose. Nitrification trials using various loads and based on different degrees of aeration intensity and hydraulic conditions, together with tests relating to biomass preservation during plant outages, were undertaken at an experimental facility. The water temperatures were set at 14°C and 25°C, with air temperatures set within the 10°C to 30°C range. Process configurations, plant design (also taking temperature correlations into account), operating aspects, energy consumption and costs are explained in the manual.

For sewage sludge treatment, separate aerobic and anaerobic stabilisation processes, composting, lime treatment and natural sewage sludge dehydration and drying methods were scrutinised. The attainable degrees of stabilisation, disinfection and dehydration are set out in the manual. The temperature range investigated extended from 5°C to 55°C. One principal result of the investigation is a set of recommendations on optimum process times relative to different treatment temperatures, for example, for aerobic and anaerobic sewage sludge stabilisation and the permissible surface solids loading rates for natural wastewater processes in different climatic zones.

Systems and simulation

In this section of the manual, first some basic cost accounting terms are explained, taking into consideration terms frequently used at an international level, and instructions are given on how to carry out profitability investigations taking whole plant life cycles into account. On the basis of assimilating the experience available, mean values and bandwidths for various cost categories and for the costs of different wastewater treatment processes are set out in a number of charts.

The adaptation of simulation models involves performing four tasks: providing modules for generating missing input data; adapting the existing ASM3, FUKA (activated sludge) and ADM1 (anaerobic processes) models to changed conditions such as high

Sedimentation at the Haifa wastewater treatment plant. Credit: Dahlem Consulting Engineers, Germany.

wastewater temperatures; simulating attached growth treatment processes using a modified ASM1 model; and developing a wastewater lagoon model. Data from five other projects in the Joint Project were used to adapt or perfect the simulation models. The corresponding parameters or equations used for adapting the models are stated and the use of the latter is illustrated by results supplied for this purpose.

Two other projects looked at the adaptation of a wastewater treatment plant to enable it to meet increasing requirements or cope with increasing quantities; here, various wastewater treatment processes were considered and a tool kit was developed for assessing and visualising process variants. The means provided by the tool kit for analysing and selecting model or design approaches for the various processes highlighted the considerable differences in the results of the various design approaches, which had also become apparent in other projects (nearly 250% in the case of the activated sludge process, for example), and also the substantial impact of wastewater temperature.

Conclusions and future prospects

On the whole, the research initiative led to a wealth of information and resources for adapting wastewater treatment technologies to the conditions in various countries and regions. For the first time, quantitative recommendations are now available to deal with a variety of phenomena with which we were quite familiar in qualitative terms – for instance, consultants know that an activated sludge reactor can be smaller if the wastewater temperature is higher (qualitative), but by how much, exactly, in figures (quantitative)?

First and foremost, the impact of wastewater temperature should be mentioned here. In all projects concerned with questions of design, this is the major factor to be taken into account when it comes to adapting wastewater and sewage sludge treatment processes to other climatic conditions. The increases in performance with rising wastewater temperatures that came to light in various projects were of a similar order of magnitude. However, attention has to be paid to the fact that these increases in performance – which also bring, as a general rule, the possibility of considerably smaller reactor volumes – do require measures to prevent operating problems such as silting up or an inadequate oxygen supply.

The results obtained in the individual research projects and the recommendations and planning instruments based on them are going to be compared with the experience obtained from routine operations, and will be updated as required. In the same vein, it is both desirable and to be expected that this report will prompt people to carry out further investigations and submit further field reports, particularly in the target regions.

More extensive investigations by the institutions already involved in the project as well as new partners are currently providing research work with this aim in mind. During the newly-launched, BMBF-sponsored Joint Project entitled Exportorientierte Forschung und Entwicklung auf dem Gebiet Abwasser –Validierung an technischen Anlagen (EXPOVAL) (Export-oriented research and development in the wastewater field – validation using large-scale plants), the results obtained from the first project phase are being validated and supplemented to produce further design rules geared to a hands-on approach.

In particular, the wastewater treatment processes being examined are the activated sludge process, the trickling filter process, wastewater lagoons and anaerobic wastewater treatment. For aerobic wastewater treatment, submerged diffuser systems and the design approaches associated with them are also being tested and validated. Another important aspect is the reuse of treated wastewater and the treatment and recycling or disposal of biosolids. Six universities and ten industrial partners / consultants are involved in this ongoing work.

In the new project, the design algorithms evolved will be validated primarily on the basis of trials at existing large-scale plants in the target regions. High temperature conditions remain the focus of attention. For example, trials are taking place at large-scale plants in China, the United Arab Emirates, India and Turkey. As well as the reports on the individual projects, the results of the completed research initiative have been compiled in two anthologies[1].

Details of these anthologies, the individual projects, the individuals conducting the projects and the universities and companies involved with them, as well as the contact addresses in each case, are to be found on the web at http://dbs-lin.ruhr-uni-bochum.de/wasserverbund.

Upon the conclusion of the new Joint Project, there are plans to compile the validated design rules for all the processes that were examined in an anthology to be published by Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA, the German Association for Water, Wastewater and Waste). DWA's existing body of rules and standards, including, for example, Standard A 131 on the Dimensioning of Single-Stage Activated Sludge Plants, is established as a major tool for the design and dimensioning of wastewater plants in Germany, and is also increasingly in demand at an international level.

The design and operating recommendations made in this body of standards are, however, primarily geared to boundary conditions in Germany and Central Europe. Consequently, the publication planned as part of the follow-on project will provide, for each process, a comprehensive, adapted design recommendation that will enable each design to be implemented in the target regions under the revised boundary conditions. ●

About the authors

Hermann M Orth is a Professor at the Ruhr University of Bochum, Germany.

Peter Wulf is Head of the department of wastewater treatment plants at Emscher Gesellschaft fuer Wassertechnik mbH, Essen, Germany.

Note

[1] *Anforderungen an die Abwassertechnik in anderen Ländern (Requirements to be fulfilled by wastewater technology in other countries), and Leitfaden zur Abwassertechnologie in anderen Ländern (A manual on wastewater technology in other countries).*

Aerobic granular biomass: the new standard for domestic and industrial wastewater treatment?

A new granular biomass wastewater treatment technology called Nereda has been developed as an alternative to the traditionally-used activated sludge process. **ANDREAS GIESEN, RONALD NIERMANS** and **MARK VAN LOOSDRECHT** discuss Nereda's advantages over activated sludge and the promising results from its pilot- and full-scale plants.

Municipal wastewater treatment using Nereda at Epe sewage treatment plant, The Netherlands. Credit: www.Nereda.net

For almost a century the conventional activated sludge process (CAS) has served as the world's standard method for biological wastewater treatment.

It is capable of extensive organic carbon, nitrogen and phosphorus removal with a high operational flexibility. However, a major drawback of the CAS process is the purifying sludge or biomass, with micro-organisms growing in fluffy floc-like structures that settle poorly and require a relatively large total plant footprint. Large secondary clarifiers – tanks necessary to retain the biomass in the system – account for part of that footprint, especially in countries with combined sewage systems and thus flow variations. For extensive biological nutrient removal (BNR) the purifying biomass needs to encounter alternating aerobic and anoxic / anaerobic conditions. To achieve this, large water volumes need to be recycled within the CAS process, which adds complexity to both design and operation of BNR CAS plants. The nature of the biomass in the CAS process makes it difficult to meet curent, extremely tight, effluent requirements.

In order to overcome these drawbacks a growing amount of institutes and universities are now focusing their research on a new process, in which aerobic granular biomass replaces the role of the flocculent activated sludge. Recently, as an outcome of an extensive Dutch national research and development programme, a breakthrough technology has become available with proven added-value in various industrial and domestic wastewater treatment plants. This so-called Nereda technology is based upon the specific characteristics of aerobic granular biomass and is considered to be the first of its kind applied at full-scale. In practice the technology distinguishes itself from traditional activated sludge systems through significantly lower energy and chemical consumptions, process robustness, its compactness, and remarkable lower investment and operational costs.

Aerobic granular biomass

In the late nineties, the Netherlands' Delft University of Technology and the German Technical University of Munich initiated research to develop aerobic granular biomass and demonstrated that by changing process conditions during aerobic purification, biomass does not aggregate into flocs, as is the case in CAS, but grows in compact sludge particles instead. These particles, with a typical minimum size of 200 microns, which do not coagulate during sedimentation and withstand shear stress, are known as 'aerobic granular biomass'. They resemble the granules found in anaerobic purification systems and match their excellent settling properties. The Delft inventors were granted wordwide patents for growing these granules and to use aerobic granular biomass for wastewater purification. These patents were transferred to consulting engineering firm DHV, that has scaled-up, matured and commercialized the invention into the Nereda technology. Alongside municipal and industrial launching

Reclaim storage-pond containing Nereda effluent for irrigation. Credit: www.Nereda.net

customers and collaboration with various research institutes, a unique public-private collaboration comprising the Dutch Foundation for Applied Water Research (STOWA), Delft University of Technology, DHV and six Dutch District Water Boards was instrumental in the scale-up of the technology. This development was supported by several Dutch and European innovation grants.

Fundamental research has been booming ever since and has given in-depth insights into the granulation process, though not all mechanisms are yet fully understood. What is clear is that stable granulation can be obtained if sufficiently high sedimentation selection pressure is applied in combination with a selection of slow-growing bacteria that produce biopolymers as a physical matrix for the granules. These specific process and operational conditions are crucial and can be best achieved using a batchwise operation.

The Nereda technology uses an optimized sequencing batch reactor (SBR) cycle in which fill and draw are efficiently combined in a first step. During this feed step the influent is distributed at the bottom of the reactor and effluent is simultaneously withdrawn at the top. Thanks to the granular biomass high specific hydraulic loadings are possible while bioconversions take place in the settled biomass particles. The second step is that during aeration, extensive biological oxidation and purification take place. An important process feature in this step is that oxygen will penetrate only partly into the granule, as it will be consumed by autotrophic- and heterotrophic organisms in the outside layer, resulting in anoxic and anaerobic zones in the inside layers of the granule. Subsequently, efficient simultaneous nutrient removal is achieved without the need for separate reactor compartments – transport of nitrate takes place by diffusion, not by pumping. In the last step of the cycle the settling of granular biomass takes place. Since the granules have excellent settling properties, this third step takes only a few minutes.

ABOVE:
Left: approximately 8g/l granular biomass after five minutes of sedimentation. Right: approximately 4g/l activated sludge after same sedimentation time. Credit: www.Nereda.net

RIGHT:
Nereda in use for municipal wastewater treatment at Gansbaai sewage treatment plant, South Africa. Credit: www.Nereda.net

Granule stability

Whereas robustness of wastewater treatment using anaerobic granules, and particularly the methanogenesis, are known to be relatively vulnerable to process conditions and changes in wastewater composition, experiences at laboratory- and full-scale show that the stability and robustness of aerobic granular biomass even outperforms those of activated sludge. The stable biopolymer backbone of the compact granule seems to protect the biomass to a certain extent during process set-up and short-term toxic conditions. Further, the high concentration of biomass makes the process less sensitive and quicker to restore after an upset.

Sustainability and cost effectiveness

Life cycle analysis shows that the Nereda technology is a more sustainable alternative compared to conventional processes. The energy consumption for a BNR plant is at least 20% lower since less pumping equipment is required. Also, the technology produces a remarkably high effluent quality, in most cases without the use of chemicals, thanks to the batchwise operation of the process. In addition, the technology requires lower amounts of construction materials and mechanical equipment, resulting in a lower embedded carbon dioxide footprint.

The concentrated biomass and its excellent settling characteristics substantially reduce treatment tank volumes and can reduce the plant footprint by a factor of four. Furthermore, the optimized constant volume sequencing batch cycle results in uncomplicated designs with a reduced amount of mechanical equipment. For example, separate clarifiers and return sludge pumping stations

will not be required. This lowers the direct plant construction costs, and, in case of plant retrofits or extensions, the existing plant plot will often prove large enough to accommodate a newly-built aerobic granular biomass system. The operation and maintenance costs are also attractive as a result of the limited use of mechanical equipment, the absence of chemical dosings and the high energy efficiency of the process.

Applications

Existing full-scale installations and Nereda projects in the pipeline show the wide potential application range of the new technology. In many projects, whether being greenfield, retrofit or upgrade, the technology in technical and financial scenario evaluations came out as the preferable solution.

Depending on the wastewater flow and composition, a Nereda plant may comprise multiple modular reactors (often two or three) or a feed buffer tank plus one reactor. Since the detailed configuration of the reactor is quite flexible, existing conventional continuous activated sludge or SBR plants often can be converted for increasing existing plant capacity or meeting more stringent effluent requirements. Hybrid capacity extension, with a new aerobic granular biomass system operating in parallel to

Table 1: Influent and effluent data from the municipal demonstration installation in South Africa

Parameter	Influent (mg/l)	Effluent (mg/l)	Requirement (mg/l)	Efficiency (%)
Chemical oxygen demand Total	1265	46	75	96
total Kjeldahl nitrogen (sum of organic nitrogen, ammonia and ammonium)	102			
Ammonium	75	< 2	6	> 98
Total nitrogen		14	15	89
Total phosphorus	19	5	10	75
Suspended solids	> 1000	< 10		> 99

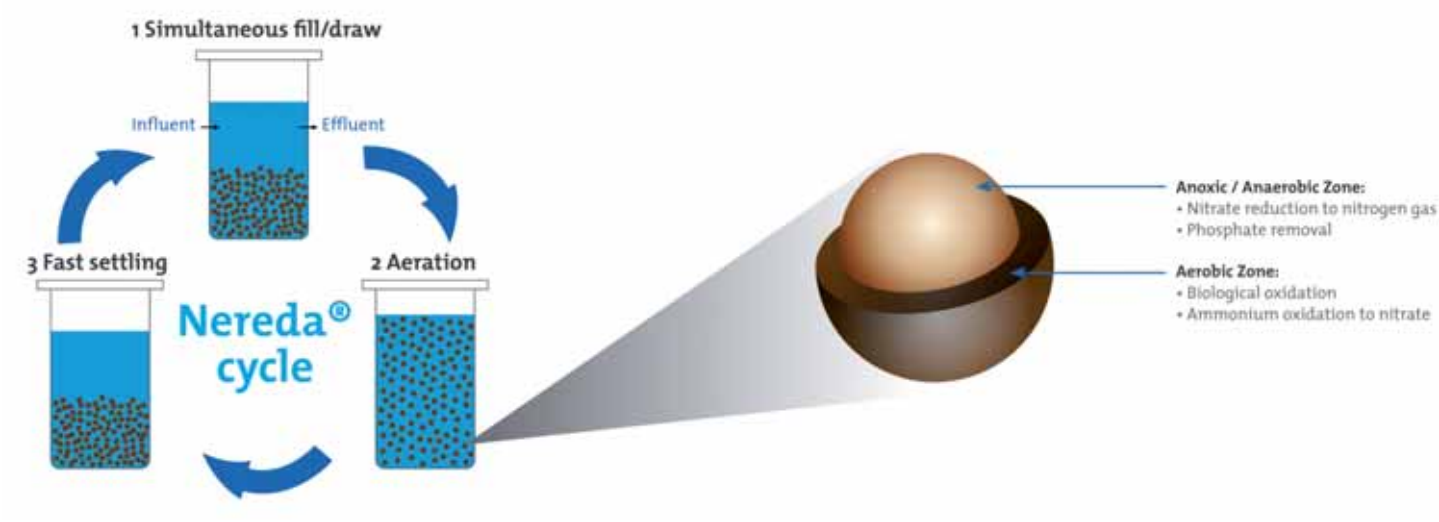


Figure 1: The Nereda cycle and a magnified granule. Credit: www.Nereda.net

an existing CAS, also showed in various projects to be the most cost-effective option to meet the desired goals.

Scale-up

Delft University of Technology invented an innovative approach to growing and maintaining aerobic granular biomass, and Dutch Water Boards and DHV recognized the potential added-value for sustainable and cost-effective wastewater treatment. All stakeholders involved established a unique Dutch public-private innovation collaboration– the so-called Nationaal Nereda Onderzoeks Programma (NNOP) – to further develop and scale-up the invention into an applied technology. Almost continuously from 2003 extensive pilot plant research was executed at various municipal and industrial sites, as part of this development.

The first full-scale Nereda was constructed in 2005 by retrofitting a storage tank for treatment of 50-250m^3/day of wastewater at a cheese specialty production factory in The Netherlands. The success of this first milestone confirmed the practical applicability of the technology. While the NNOP was working on the scale-up for larger municipal applications, the technology was further valorized by other industrial applications. For example, in 2006 the first greenfield industrial application came on-line for the treatment of approximately 250m^3/day wastewater from a convenience food industry. When in 2009 this company decided to relocate their production facility, key equipment was transferred to another location and retrofitted on-site into a Nereda treatment plant with twice the original treatment capacity. The influent chemical oxygen demand (COD) ranges from 1000-8000mg/l and the unit is fully loaded with daily peaks up to two times the design capacity. With biomass concentrations maintained at as much as 10-20g/l, sludge volume indices after five minutes that amount to only 20-30ml/g, at process temperature of approximately 40°C and absorbing large feed fluctuations, the unit consistently meets the treatment requirements with COD reductions of approximately 95%.

That the new technology can be a strong tool in de-bottlenecking or upgrading existing SBRs is illustrated by an application in the vegetable oil industry. Here, an existing SBR plant, comprising two reactors of 1600 m^3, was treating a factory's wastewater and suffered from frequent performance flaws and bulking sludge. Retrofitting these tanks to Nereda proved to be easy and effective, and resulted in significantly improved treatment performance, increased process robustness and reduced power consumption.

The scale-up of the technology for municipal application made a step forward in 2008 when in South Africa. A demonstration installation was started-up for treatment of municipal wastewater. The installation is designed to treat 4000m^3/d of high strength septic influent. It shows a remarkable high performance (see Table 1), especially when taking the minimal operational attendance and high solids load into account. Most of the treated wastewater is reused for irrigation.

Building on the experience of the NNOP programme and the excellent results of all municipal and industrial full-scale installations, the step to a larger municipal Nereda application was made when, at the end of 2011, the first municipal full-scale installation at Epe sewage treatment plant in The Netherlands came on-line. This plant is owned by District Water Board Veluwe, has a design capacity of 59,000 PE and treats up to 1500m^3/h municipal wastewater with a high contribution of industrial waste from slaughterhouses to challenging effluent requirements of total nitrogen < 5mg/l and total phosphorus < 0.3mg/l at Dutch climate conditions.

With full-scale plants running and several new projects in the pipeline, strong interest in the new technolgy has been aroused in many countries in Europe, Asia, Australia and America. For example, currently the municipal treatment plants for Municipality Stellenbosch in South Africa and District Water Board Rijn and Ijssel in The Netherlands are under construction, while many others and projects for food, beverage and chemical industries are being prepared.

The emerging new standard

Feedback and lessons learned from the first Nereda installations clearly confirm the added-value of this modern technology. In particular, the full-scale demo installation in South Africa, the full-scale plant at Epe and a growing amount of industrial applications demonstrate the reliability of the process under 'harsh' conditions such as fluctuations in wastewater composition, temporary power failures and limited attendance of operation and maintenance staff. While aerobic granular biomass technology research is booming worldwide, BNR experts identify the technology as the first real process breakthrough in generic biological purification of municipal and industrial wastewater in decades. This has also been shown by various national and international awards for Nereda because of its quality, innovation and sustainability. With the technology now being scaled-up and applied in various wastewater markets and countries, it will be difficult to find a technology as affordable and sustainable in wastewater treatment as Nereda to meet the world's sanitation and water pollution challenges. The near future will prove whether or not this emerging technology indeed will evolve into the new 'world standard' for aerobic wastewater treatment. ●

For more information, visit: www.nereda.net

About the authors

Andreas Giesen is Director of Innovation & Product Development, Water at DHV BV, Amersfoort, The Netherlands. Email: nereda@dhv.com

Ronald Niermans is a Project Manager at DHV BV, Amersfoort, The Netherlands.

Mark van Loosdrecht is a Professor and Group Leader Environmental Biotechnology at the Department of Biotechnology, Faculty of Applied Sciences, Delft University of Technology, Delft, The Netherlands.

BESSE project brokers knowledge transfer for sustainable sanitation

● The European project BESSE has been working with a range of organisations to determine how information on wastewater treatment processes is disseminated, the challenges that hinder knowledge transfer, and how brokerage mechanisms can overcome these to help a more sustainable sanitation approach to be undertaken by wastewater service providers. **MINNIE HILDEBRAND** outlines the project's approach to knowledge brokerage.

To protect water quality in the Castel Sant'Angelo aquifer, BESSE facilitated information sharing to reduce groundwater infiltration to the sewerage network.

Today's sanitation technologies and management systems are largely based on approaches developed in the 19th and 20th centuries, so current sustainability concerns, such as reduction of energy use and environmental impact (apart from effluent quality), were not considered in these initial approaches. Research and technology developments of recent years can potentially contribute to a more sustainable wastewater chain. Yet, it seems that they only develop into full applications on a very limited scale. Why do some new technologies and bodies of knowledge find practical applications and others not?

The BESSE (Brokering Environmentally Sustainable Sanitation for Europe) project has been investigating this question and argues that knowledge brokerage can play a central role in creating a more sustainable wastewater sector. The project has also been investigating the gaps that exist between the processes linked to the production and transfer of knowledge and what knowledge is actually being transformed into applicable implementation models. The same applies to the knowledge produced in scientific research areas and the knowledge that is being employed.

Environmentally sustainable sanitation is a controversial concept for Europe as it is a type of solution that has been spreading from developing countries to developed countries. There is a lack of convergence on whether the different technological solutions are really sustainable or not. However, there is an urgent need for a solution that moves away from traditional sanitation technologies which are, for the most part, not seen as sustainable. It is at this juncture that the European Union's commitment to develop a widespread sustainable sanitation approach is crucial.

The European Commission-funded project BESSE[1] is a collaborative effort of numerous academic, professional and non-governmental organisations[2] that set out to understand information blockages and factors that hinder the dissemination of available knowledge and to identify knowledge brokerage mechanisms to overcome obstacles. The project started in June 2009 and will end in May 2012 and the main project output will be a set of policy guidelines on knowledge brokerage in support of environmentally sustainable sanitation (ESS).

Knowledge brokerage

What is knowledge brokerage? Who brokers and to whom do we broker? Is knowledge brokerage only necessary if there is a demand?

The hypothesis of the BESSE project is that sanitation knowledge is not always passed from one actor to another and that this hinders the use of knowledge.

The traditional idea of knowledge brokerage is that there is a gap between those that need the knowledge and those that have the knowledge. A broker is then necessary to bridge this gap. For this one needs a willing

Case study: the Dutch water sector

Three main groups of actors are involved in innovation in the Dutch wastewater sector: water boards, charged with the responsibility for waterways, water levels and wastewater treatment and use of treatment technologies in practice; research organisations and universities that often develop new ideas and materials and investigate the mechanisms behind new technologies; and entrepreneurs and engineering firms that develop, apply and market the technologies.

Historically, costs and effluent quality have been the primary concerns for water boards as it is related to public health. New technologies are only considered when they are cheaper, provide cleaner water, and when old technology needs replacement.

It is against this background that the Dutch pilot project is being executed, involving the Waterschapsbedrijf Limburg (WBL).

The company plans to renovate and extend two wastewater treatment plants and build one new plant to create one multi-purpose plant, including new techniques and technologies, and the way in which the plant will be constructed.

This entails changing the way in which decisions are made and how to engage with more sustainability aspects within the current thoughts framework. The WBL pilot project is not being approached in a 'business as usual' manner. It now has to focus on a new green approach to designing the treatment plants to include energy reduction, greenhouse gas reduction, flexibility in building methods and materials, the reuse of raw materials and multi-purpose water, and the full adaptation to environmental factors.

This means that instead of focusing almost exclusively on the costs of various options, WBL will experiment with a new approach in which the different remodelling options are evaluated on the basis of a set of criteria (traditional ones such as overall costs and effluent quality, but also energy use, carbon dioxide emission, use and reclamation of raw materials and greenhouse gasses), as well as increasingly 'green' approaches to these criteria in terms of minimum requirements including effluent quality.

Source: Some aspects of this case study is based on the article 'Kennismakelaardij voor duurzame afvalwaterzuivering', H2O, Vol. 11, 2011, by Erik Aarden and Ragna Zeiss (BESSE Coordinator, Maastricht University)

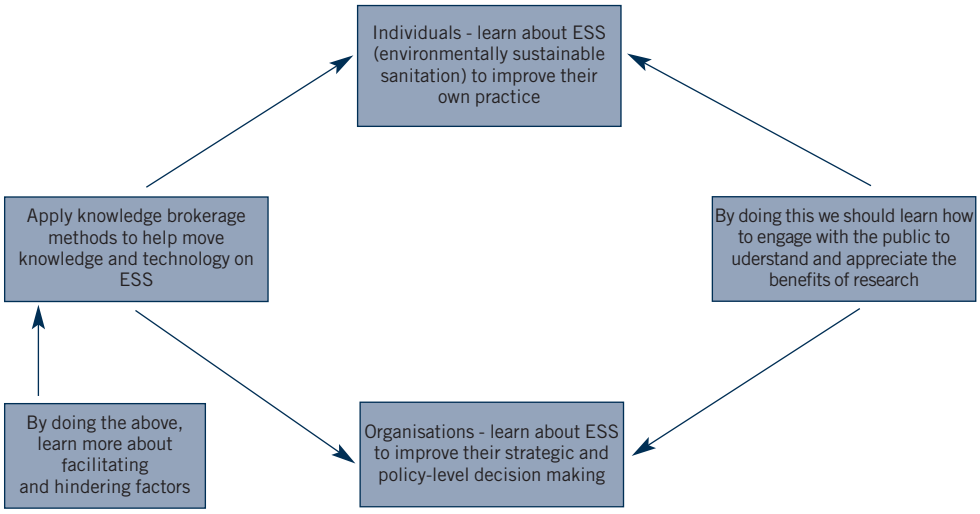


Figure 1: Knowledge brokerage and project aim framework

recipient. BESSE broadens this definition: knowledge brokerage entails more than communication as knowledge needs to be adjusted and translated – in terms of language but also in terms of translation to local contexts. Knowledge brokerage is not a linear process from the producers of knowledge, via an intermediary, to the end user. The brokering may happen between different actors and on different levels simultaneously, also without a central mediator.

Knowledge brokerage is thus a process that helps to move knowledge and technology from one place to another in order to help individuals and organisations to learn and improve. Alongside this, knowledge brokerage methods (in the BESSE context) are meant to overcome hindering factors and to maximise the exploitation of knowledge relevant for sustainable development. This is interpreted to mean learning how to use knowledge brokerage methods to engage the public to understand and appreciate the benefits of research.

From the questions, a framework was developed to produce answers. Figure 1 shows what is meant by knowledge brokerage in the BESSE context, and what the BESSE project did.

Conceptual framework for knowledge brokerage

The project framework conceptualised brokerage as having six facets: inform; consult; match-make; engage; collaborate; and build capacity.

The research developed a number of knowledge brokerage mechanisms that was tested in pilot studies in real time in three contextually different European regions, namely Mediterranean Europe (Italy – Castel St Angelo); Northern Europe (Netherlands – Limburg) and Eastern Europe (Bulgaria – Pernik) (see boxes).

Two research questions emerged: What are the factors generating the problem and what is the role that knowledge brokerage can play for ESS?

To answer this, researchers identified hindering and facilitating factors that play a role. The data collected during the first phase of the research (literature and documentation reviews; case studies; and interviews with role players) supported the aims of achieving the second objective.

The first results included a map of these factors and a conceptual framework was drawn up based on the work done. This map consists of 142 items: 61 obstacles; 29 facilitating factors and 52 practices adopted by sanitation players facing obstacles or enhancing facilitating factors.

A model was then developed by devising a techno-scientific innovation cycle, to properly 'place' each factor within a general picture. It illustrates how knowledge brokerage plays a key role in knowledge transfer, promoting social pressure for innovation, transforming this pressure into new policy demands and facilitating the enhancement of research policies in support of sanitation research.

A more green approach to wastewater treatment plant design is being undertaken in Limburg, The Netherlands.

Pilot studies

The next phase of the project included pilot studies that were designed to identify effective communication between researchers, policy-makers and water companies taking into account the inter- and intra-disciplinary nature of ESS brokerage as well as its public and socio-political contexts. The case study framework that resulted from this acted as a methodological guide during the research. A single methodology was used to facilitate cross comparisons between the different scenarios.

The case studies looked at what happens to the knowledge in a brokerage process and what knowledge can be and is used by the actors in different contexts, as different problems looked at different routes for solutions. What the research found was that knowledge moves between the contexts and decision makers and that it is important what the actors do with the knowledge when it gets to the point when the components connect.

Case study: Castel Sant'Angelo, Italy

An important Italian groundwater source, located in Castel Sant'Angelo, with some of its springs connected to the Peschiera aqueduct, is one of main water sources for Rome. Thus, protecting the quality of water in this aquifer is crucial.

The current sanitation system is complex as it comprises several sub networks that collect wastewater from the different small urban areas in the municipality. The reliability of system is low because of the morphology of the territory, and the age of the pipes, etc. The connections between the different elements of the pipeline cannot guarantee optimal functioning and groundwater intrusion in the pipeline has been registered for several years. The wastewater is diluted and, consequently, the wastewater treatment plant does not function well.

The main project goal was to set in motion awareness raising processes regarding the role of sewerage in the sustainable management of the integrated water cycle, to enable the creation of a sense-of-ownership of the local community to accelerate the impacts of innovation.

BESSE facilitated the communication and knowledge exchange among the four most important actors involved in the sanitation management, namely the municipalities, technicians, scientists and the local community. They focused on integrated validation with the aim of supporting the municipality in evaluating effectiveness; a long-term monitoring programme to scrutinize the effectiveness of the reduction of groundwater intrusion: and the development of a communication and information plan to facilitate the creation of a sense of community.

About the author
Minnie Hildebrand is Consultant to the Development Division, International Water Association, Netherlands.

Lessons learned

To conclude the process of identifying the lessons learned, the next step will be to identify the changes brought about by the knowledge brokered in each of the cases studies (pilot projects). Once the changes have been identified, the reasons for the change will be distilled, being the things that enabled the changes to occur. It is important to answer questions such as 'what is there at the end of the knowledge brokerage attempt that was not there before', and others that can show movement as a result of the knowledge brokerage process.

Project partners will conclude the research by preparing an activities matrix using the keywords: knowledge brokerage activity; significant change and result; and key factor that brought about change. The results can include both positive and negative aspects. This matrix will represent the key knowledge brokerage activities, set against the results or change, and then give the reason and evidence for the change. This will illustrate what type of activities yield the best results, and if negative, what subsequent intervention may give a positive result. ●

Notes

[1] Funded within the context of the Seventh Framework Programme 'Environment'. It aims to contribute to the Renewed Sustainable Development Strategy of the European Union through the enhancement of the links between sanitation policy and research on sustainable sanitation development.

[2] Comune di Castel S.Angelo di Rieti (CSA) (Municipality of Castel Saint' Angelo of Rieti), Italy, Department of Technology and Society Studies, Research Institute on Arts and Social Sciences, University of Maastricht (UM), Netherlands, International Water Association (IWA), Italian Branch of the Council of European Municipalities and Regions (AICCRE), Italy, Laboratorio di scienze della cittadinanza (LSC) (Laboratory of Citizenship Sciences), Italy, National Council for Research of Italy (CNR), Italy, Pernik Municipality on behalf of the Water Supply and Sanitation (PNK), Bulgaria, Research Centre Regional and Global Development (REGLO), Bulgaria, Water Board Company Limburg (WBL) Netherlands, Water, Engineering and Development Centre, and Loughborough University (WEDC), UK. www.besse-project.info/consortium-partners.

Case study: monitoring quantities and quality of industrial wastewater discharge in Pernik municipality, Bulgaria

The pilot project in Pernik concerns the rehabilitation of the wastewater treatment plant and the collection and application of knowledge about wastewater treatment.

The treatment plant was constructed in the late 1970s, using technology and equipment typical for Eastern European standards. Issues of concern are that the station works at a third of its initial capacity and productivity and organisational deficiencies are problematic.

The plant treats the wastewater from industry and 99,000 inhabitants and includes mechanical and biological wastewater treatment: anaerobic stabilisation of the sewage sludge in two-stage methane containers and dehydration of sludge in drying fields. Nitrification, denitrification and phosphorus removal is not included. The plant is at risk of overflow if minimal capacity is exceeded.

This pilot project is being implemented in conjunction with another EU project and its main focus is to increase the connection rate of small-scale industrial enterprises to the municipality sewerage system through effective knowledge brokerage mechanisms.

This entails firstly identifying specific knowledge brokerage mechanisms that will facilitate the connections and improve the quality monitoring of the discharged wastewater, and secondly to improve relationships and concomitantly knowledge exchange amongst the stakeholders in the municipality. The third component focuses on supporting the training of water supply and sewerage company inspectors to monitor wastewater discharged, and lastly the project is tasked with increasing the level of awareness of the local population concerning wastewater sanitation issues.

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Siemens centre displays future city ideals

● Siemens has been creating a new sustainability centre to display knowledge of sustainable urban concepts in a permanent public exhibition, and to become a global knowledge hub and conference centre. **CATHERINE FITZPATRICK** reports on the motivation behind its development, as well as the range of sustainable design elements included in its construction.

East London has seen a new eye-catching addition to the Royal Victoria Docks taking shape – a £30 million ($46.9 million) angular glass building called The Crystal.

The Crystal is a sustainable cities initiative by global engineering firm Siemens, which will be a visitor attraction and a global knowledge hub for urban planning and design to sustainable technology, in the areas of water, transport, energy and security. The Crystal has been built in London's new Green Enterprise District, which, covering 42km^2, has been formed to develop East London as centre for low-carbon projects, sustainable infrastructure, and green enterprise.

Drawing inspiration from the Crystal Palace which in 1851 held London's Great Exhibition of the latest in Industrial Revolution innovation and technology, Siemens says that The Crystal has been established to focus on solutions for a new age of urban development, not only being a conference centre and a 'Centre of Competence' for Cities for Siemens' new Infrastructure & Cities Sector, but also a visitor exhibition on the issues surrounding sustainability and city development.

'The project began when the City of London and the London Borough of Newham invited Siemens to get involved in the creation of a Green Enterprise District stretching across East London,' explains Claire Jarvis, Director of Communications, Siemens plc. 'The area, which is made up of undeveloped plots of industrial land, has been identified as a key area for green investment in the UK. We believe the Green Enterprise District presents an ideal location to develop a global hub for urban sustainability and urban sustainability learning.

'Cities are already home to more than 50% of humanity and it is forecast that 60% of the world's population will live in cities by 2030, 70% by 2050,' she continues. 'However, whilst they account for around 80% of economic output, cities are also responsible for the majority of greenhouse gas emissions. So, in order to ensure a secure future for generations to come, cities need to balance their overall environmental impact, making better use of finite resources.'

Sustainable design

Built to be not only a hub for knowledge brokering but also an excellent example of sustainable design, Siemens is aiming for The Crystal to achieve the highest standards in the US' LEED (Leadership in Energy and Environmental Design) and UK's BREEAM (BRE Environmental Assessment Method) ratings.

Energy for the building will be generated by solar panels on the roof and ground source heat pumps, and water will be also be heated on the roof through using solar energy. A rainwater harvesting system will take water from the roof to be treated to a potable standard for drinking water, whilst a blackwater system will treat 100% of the water used in the building for reuse in flushing toilets and irrigation of the surrounding landscaping. Water use in The Crystal will be minimised through the use of a smart irrigation system that monitors soil moisture, water efficient appliances and low flow fittings.

'What we are driven by is to have [The Crystal] internationally recognised,' says Darren Dean, Project Manager at Siemens. 'At the heart of that is water reuse and sustainable water use, so that's where we entered the project from a water perspective – to recycle as much water as possible and to use as much of the natural resource available (rainwater).

'Its design is roughly around 36 litres/second,' says Dean of the rainwater collection system. 'Overall we're looking to target somewhere in the region of about 800m^3 per day of reclaimed water, whether that's from rainwater or from wastewater from the building itself.'

The Crystal's blackwater will be treated by a Siemens membrane bioreactor he says, before being dosed with chlorine dioxide. 'The membrane bioreactor is relatively new for this kind of scale,' he continues. 'The rainwater system is also a membrane system that's using an ultrafiltration membrane. What we're trying to do here is prove the concept of reuse. [The technologies being used are] proven technologies, it's just how we've put them together that is still relatively novel. I think that's in keeping with the purpose of the building, and what we're trying to demonstrate – it's not necessarily seen as technology, it's what's possible [for sustainable design].

Cities of the future

In March the UK Environment Agency released a report detailing drought prospects for spring and summer 2012, highlighting that the south-east and east of England are already in a drought after the previous six months were the driest since records began in 1921. The Crystal is therefore ideally placed to be an example of low water use design, but also a tool to increase public awareness of water issues. 'There will be an exhibition and part of that will be focused on water conservation issues, and not necessarily just about treatment, but catchments, sustainability, etc.,' says Dean. 'It's really trying to encompass as much of the accepted practices as there are now, and maybe what is possible as well.'

Events for invited guests will start from the middle of July, whilst the building will open to the public at the end of September. ●

An artist's impression of the completed building. Credit: Siemens.

Environmental excellence for shopping centre management

● The management company of Portugal's Almada Forum shopping centre has received strict environmental certification for its environmental management programmes within the centre, the awarding of which has required extensive communication of performance and actions undertaken to raise environmental awareness. **LIS STEDMAN** spoke with **AMÉRICO SILVA** about the shopping centre's green credentials

The Almada Forum shopping centre

Companies are increasingly adopting water saving measures, as the message that there are significant benefits spreads. Multi Mall Management has gone a step further and has become the first management company in the world, it says, to receive EMAS (Eco-Management and Audit Scheme) certification for the management of its Almada Forum shopping centre in the city of Almada, Portugal.

The centre attracts thousands of visitors each year, which provides the management with an excellent opportunity to disseminate its green message. The EMAS certificate implies a level of environmental excellence and communication to stakeholders, and it is a working tool for those wanting to commit to evaluating, managing and improving their environmental performance, and providing evidence of this to others. This of course naturally extends to water and its use and conservation.

The operations manager for the Almada Forum, Américo Silva, explains why the organisation decided to achieve EMAS certification: 'EMAS registration represents excellence in environmental management, and fits in terms of communication with the strategy of Multi Mall Management, particularly regarding the involvement and awareness of the community and all stakeholders with environmental and sustainability issues.'

He notes that EMAS is a step beyond the ISO 14001 environmental standard. 'EMAS registration is much more demanding in terms of performance than 14001 certification, which we have also had since 2006, forcing us to publish for all parties involved our performance and actions taken to raise awareness and the involvement of the community and shopkeepers. An environmental statement is prepared about the mall's performance, which is verified by auditors accredited by the Portuguese Environment Agency.

'Besides the recognition from other parties, we have improved our environmental performance, and therefore have made cost savings for the management of the shopping mall – it uses less energy, less water, has better separation of waste, increased recyclables production, and increased motivation of employees for a common cause, which ensures they perform better.'

Centre sustainability

The company has environmental management programmes for each environmental area and is committed to constantly improving its performance, particularly in energy and water consumption, waste recycling, training, programme management and awareness raising. The mall also runs drills and training programmes to prevent environmental accidents.

Potable water reduction is achieved by abstracting groundwater for irrigation, toilet and urinal flushing, for the lakes in the grounds and the heating and ventilation (HVAC) water system. The groundwater is collected in reservoirs and treated with chlorine before use, and the water in the HVAC systems is also treated with chemicals to ensure its quality remains good and there is no need to replenish it.

Other water saving measures include special low-flow taps in the bathrooms that reduce water use by 60%, and the use of groundwater for cleaning duties. Mr Silva explains that 'we do not waste drinking water where we can use groundwater'.

He adds: 'It should be noted also that the best way to reduce consumption is to ensure efficient management of the teams so that everyone has a proactive stance, taking action or informing our service to ensure fast and effective interventions.' This includes staff checking for leaks in the irrigation system, failures of the taps or toilet flushing systems, and optimised use of water by the cleaning staff.

Mr Silva notes: 'We also have an important role in raising the awareness of our tenants and the community to rational and optimum consumption of water and energy.'

The shopping centre is also going to introduce rainwater harvesting, collecting water from the roofs and storing it in the underground reservoirs with the groundwater. This system was installed in 2011 and is scheduled to begin operating this year.

The centre also ensures that its wastewater and rainwater treatment are in line with regulatory requirements. Mr Silva says: 'In terms of drainage of domestic wastewater and rainwater, there are regulations that define the parameters for the municipality's emission limits. We use enzyme treatments to ensure that the mall meets the control parameters and we plan to have our effluent monitoring measured by accredited laboratories, which will confirm compliance with the law.'

The figures prove the mall is reducing its potable water use year on year – last year its usage was 4.3 litres per visitor, 10.4% less than in 2009 when the figure was 4.8 litres per visitor. Even though visitor numbers have increased, water use in the communal areas of the mall decreased by 28% in 2010.

The water saving and awareness programme has brought the centre significant benefits, as other businesses that have embarked on this type of project have discovered. Mr Silva concludes: 'Besides the reduction in consumption and saving of a natural resource, we have experienced a direct reduction in the cost of water, which turns out to be significant and reduces our administrative costs.' ●

Achieving water loss management through coaching a whole-utility approach

Dealing with water loss requires a holistic approach in all aspects, not just regarding the technical issues but also the important changes required for capacity building in order to accomplish the desired goals. **JURICA KOVAC** and **BAMBOS CHARALAMBOUS** outline some of the additional aspects of water loss management with a specific focus on coaching as a discipline in this field, looking at what it is, how it works and who can provide it.

It is recognised that water loss management is a multi-disciplinary activity. This can be seen in Figure 1, which shows all operational and functional aspects of water. This means that practicing water utility management requires continuous commitment, increased capabilities and a high level of appropriate knowledge and expertise.

It is important to understand and appreciate that besides the necessary technical knowledge needed regarding water loss management, other aspects must also be considered for a successful and sustainable implementation of water loss management activities through the change of existing practices. The concept of three dimensions of change was well described by Rizzo and Vermersch[1], consisting of an operational dimension, project management dimension and change management dimension.

A key element in providing the right solution is the people within the water utilities, and without proper training, coordination and assistance it is extremely hard to expect positive results. The problem becomes even more complicated with the turnover of dependable and experienced staff. The new generation of employees which will come in to fill the gap will be faced with the challenge of how to duplicate skills and experiences gained over many years by those who leave, and at the same time how to cope with accumulated water loss issues.

The management team of a water utility is responsible for recognising, understanding, defining and implementing changes. So, it is crucial to identify a change champion[2], or metaphorically, to identify a 'captain' who will lead the ship and crew through stormy waters on a journey from the existing situation into a better one. In order to transform the water utility the captain must have many qualities besides knowledge of water loss management.

It is extremely important to have people with 360 degree vision who are able to comprehend existing challenges and to provide guidance and required assistance as and when necessary and requested. Such people are called 'business coaches' and are able to provide coaching to businesses in order to assist them in moving forward and achieving their goals. 'Business coaching' is a collaborative relationship, solution-focused, results-oriented, systematic and enlightening process in which the specific remit of the coach is to work with an employee to achieve improved business results, business performance and / or operational effectiveness.

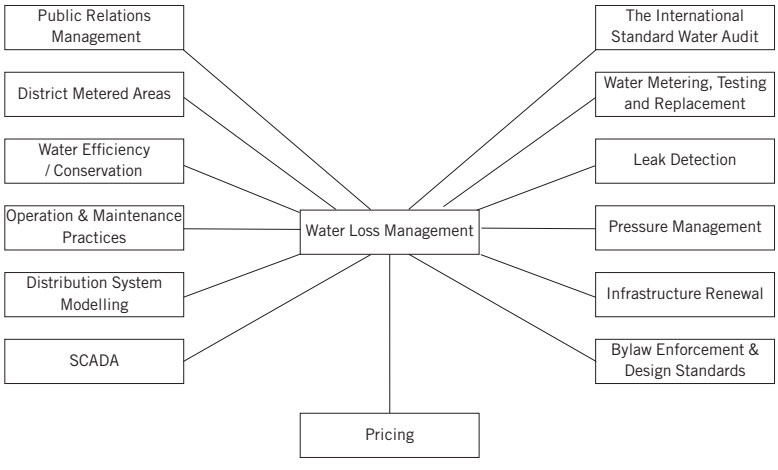

Figure 1: Multi-disciplinary function of water loss management (source: McCormack, 2005)

Existing challenges

Water losses could successfully be managed through a series of comprehensive activities covering many issues such as real and apparent losses, speed and quality of repairs, asset management, employee training, use of appropriate technology, etc., with all of these associated with the necessary financing capabilities. This comprehensive approach is challenging for any water utility management and successful examples are rare. Perhaps the main reason for this is the difficulties faced by the management to introduce and lead necessary improvements by relying solely on the utility's own human resources, technical expertise and financial capabilities.

The majority of successful examples show the importance of outsourced assistance in successfully dealing with the above problems. Outsourced assistance is appropriate in most cases such as dedicated projects, specified consultancy services and performance-

based projects.

In addition to the above, the issue of insufficient education and training programmes for water utility employees must be emphasized. It is also important to highlight the fact that water utilities are generally reluctant to adopt new strategies and technologies, with staff not responding to new challenges due to the public nature of the majority of such organizations. Without continuous, specific and dedicated education it only becomes more difficult for water utilities to tackle increasing number of problems in a constantly changing environment.

Is coaching a solution?

It is evident that the available knowledge regarding water loss management is not sufficient to secure improvements in water utilities. Outsourcing could help but is not always easily and affordably accessible. It is therefore crucial for the successful planning of activities and their subsequent implementation, to improve the ability / capacity of people working in water utilities. This would involve acquiring knowledge and experience in many different fields of expertise, such as project management, time management, document management, and human and technical resources management[3]. Sometimes, even with all this it is not enough to leverage change and additional tools such as thinking skills, learning skills, capabilities for improvisations, etc. must be sought. Beyond these knowledge layers there is even a bigger challenge on how to use these tools and skills in a proper manner.

Management and operations in water utilities and in particular those activities relating to water leakage is a daily task. Water loss management integrates all kinds of management activities at the same time (reactive, proactive, preventive, risk) and if the right solution or a balanced advice is needed it must be on a daily basis and coaches are the kind of experts best able to provide this. The more qualities a coach has, the better and more efficient their relationship with a water utility will be. Water utilities are best assisted by someone who was successful in facing these challenges and changes before, someone who was on this voyage before and who can bridge over the huge gap that exists between existing knowledge and experiences and desired goals for effective and efficient water loss management.

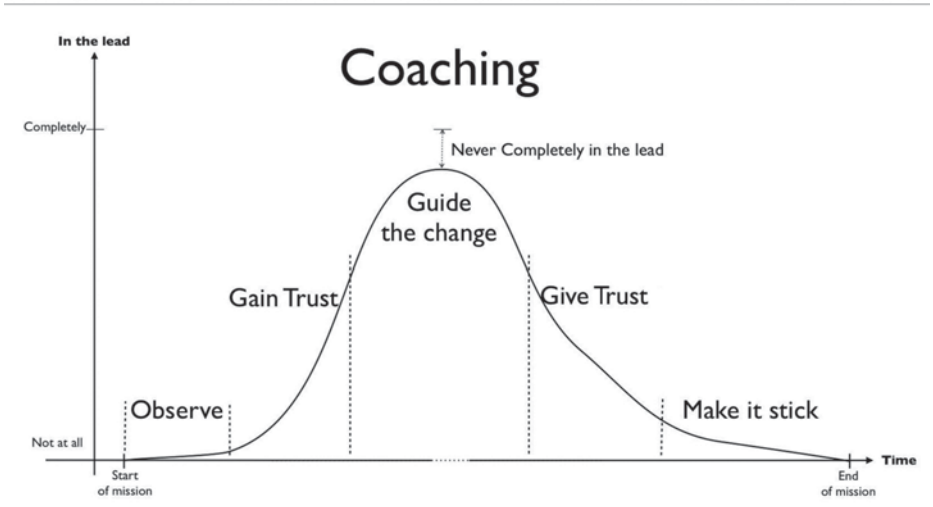

Figure 2: The steps of coaching.

How coaching works

Transfer of knowledge alone is not enough and will not guarantee that a person who acquired this knowledge will know how to use it. There is often a lack of practical guidance and application. The aim of practical guidance is through a dedicated programme of activities and a close relationship between the coach and employees to transfer skills and knowledge.

How learning works could be presented in a simplified form as follows[4]:

- Talk to me… I forget (typical example – conferences and seminars)
- Present me… I remember (typical example – practical presentations)
- Let me do it… I understand (coaching)

An important aspect of coaching is capacity building; applying a specific way of teaching which is presented in a simplified form as follows:

- I am doing it. I am explaining it. This first step serves in presenting a new issue.
- You are doing it. I am explaining it. This second step is transitional with new knowledge.
- You are doing it. You are explaining it. Final step with transferred knowledge.

The approach in coaching varies but in general could be presented with the following steps[5]: observe; gain trust; guide the change; give trust; make it stick (see Figure 2).

A coach can be a valuable assistant to the key manager (captain or change champion), or in some circumstances a temporary replacement. Guidance provided by a coach can help in all aspects of water loss management. He / she could fill in existing knowledge gap and skills with the aim to assist utilities in building their own capacities and independence over time.

Who can be a coach?

Evidently from the description above, finding a coach is not an easy task. All those with excellent knowledge of

A coaching session taking place. Credit: Stuart Hamilton.

water loss management are potential coaches, but additional knowledge and skills are needed for them to be able to provide appropriate coaching service. As it has been shown in this article, sole application or transfer of knowledge related to water loss management is not enough. From available examples in other industries and from the authors' own experience a coach must combine the following basic qualities / expertise:

- Water loss management
- Change management
- General management skills (project, time human resources, document, risk)
- Human behaviour, psychology and pedagogy
- Communication skills and motivation

It is realistic to assume that in the future water loss experts will turn their attention towards business coaching with the aim to learn and become experienced in other fields of expertise. Potential clients with specific expectations and a desire to accomplish and sustain organizational change in water loss management may use the expertise of such experts.

Examples and experiences in coaching

Examples of full-scale coaching in the water industry are still rare. Many independent consultants or consulting companies are already on the market with services very similar to coaching and with additional fine tuning of their capabilities we will soon be witnessing a rising number of coaching examples in water utilities. Until reliable data from the water industry is available, here are some general research findings.

The UK's Chartered Institute of Personnel Management reports[6] that 51% of companies (sample of 500) 'consider coaching as a key part of learning development' and 'crucial to their strategy', with 90% reporting that they 'use coaching'. More recent research in 2011 by QA Research, an independent marketing research agency in the UK, found that 80% of organizations surveyed had used or are now using coaching, but also found that while 90% of organizations with over 2000 employees had used coaching in the past five years, only 68% of companies with 230-500 employees had done the same[7].

Way forward

The knowledge gap between those who know and those who need help is huge and cooperation is necessary if effective changes in the field of water loss management are to be witnessed. Alternatively, a slow process of change with many mistakes may take place with perhaps steady declining potential for improvement, which could perhaps adversely affect organizational viability.

Coaching as a discipline presents an opportunity for water utilities to improve performance as well as to build the necessary skills, capacities and efficiency among water utility managers and technicians to assist them in dealing with the multi disciplinary field of water loss management. ●

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About the authors

Jurica Kovac is the Founder and Managing Director of Aqua Libera Ltd, Croatia and an active member of IWA's Water Loss Specialist Group. Email: jurica.kovac@mail.com.

Bambos Charalambous is Head of the Technical Services at the Water Board of Lemesos, Cyprus, Past Chair of the IWA's Water Loss Specialist Group and an IWA Fellow. Email: bambos@wbl.com.cy

City-wide, cutting-edge control for Los Angeles' wastewater assets

● The Los Angeles Bureau of Sanitation has signed a contract that will upgrade the control systems of the city's wastewater network and create a central control hub. **JIM FORCE** reports on how over the next 15 years, Los Angeles' wastewater system will become fully standardised, allowing for increased efficiency in its management.

A new $88 million contract with technology company Honeywell virtually assures the Los Angeles Bureau of Sanitation in California, US, that it will have state-of-the-art automation and control technology for the next 15 years and beyond.

The contract, signed in November, calls for Honeywell to upgrade controls across the Bureau's sprawling wastewater treatment network that treats more than 350 million gallons (560 million litres) of wastewater a day, and includes four treatment plants, 6700 miles (10,720km) of sewers, and 65 pumping stations.

Honeywell's flagship Experion Process Knowledge System (PKS) will be the platform for the new automation and controls system. Experion is widely used in critical industrial applications such as oil refineries and power stations, but this project's unique and diverse requirements will break new ground in the deployment of Experion for wastewater treatment.

'We're very excited about this project because it represents a terrific opportunity to transfer successful technology applications from one vertical market to another,' says Tracey Haslam, vice president, Americas, for Honeywell's Process Solutions business. 'We are taking business concepts from the private sector and employing them in the public sector.'

'The contract guarantees a 99.999 percent systems reliability for the city's treatment plants and collection system,' says Pete Perciavalle, vice president with CH2MHill, the consulting firm on the project. 'And it specifies that Honeywell periodically incorporate new hardware and software so that when the contract expires in 15 years, the city will have an essentially brand new control system.'

Haslam adds: 'Los Angeles is taking a holistic approach, deploying a standard system across multiple sites. The contract represents a number of best practices, including lowered risk of obsolescence, use of local resources, life cycle costing, long-term relationships, and savings to rate payers.'

The technology will replace aging and incompatible DCSs (distributed control systems) and PLC (programmable logic controller)-driven controls on equipment and collection points throughout the system, giving Bureau managers the ability to view and control the entire network from a single control room at the city's massive Hyperion Wastewater Treatment Plant.

'At the end of the day,' says Ali Poosti, the Bureau's programme manager for the controls contract, 'we'll be able to control any plant, any process anywhere on the system, from a single point.'

An artist's impression of the new Hyperion control room.

Out with the old

Parts of the existing LA wastewater control system date to the 1970s and 80s, and were supplied by a variety of vendors, some of whom are no longer in business. The result is a network of local DCSs and PLCs that do not 'talk to one another' or communicate, and prevent a system-wide, integrated control platform.

'In civil works, one pipe can be made to fit with another,' says Perciavalle, 'but this is different. Things don't fit. One vendor's proprietary software cannot be made compatible with another's.'

Poosti points out that two of the city's treatment plants use a DCS supplied by one vendor, a third uses a DCS from a different vendor, and the fourth is run by a PLC-based system. Most of the pumping stations are controlled by separate, local PLCs.

Parts have been another issue. 'It's become progressively difficult and expensive to get parts and to manage multiple maintenance agreements,' says Poosti. 'It was time to make things uniform, and control everything through one system. We needed to look at a different approach.'

A new approach

The new contract model was the key to the city getting what it needed in the way of a reliable, unified control system, the two believe.

'We asked some fundamental questions,' recalls Perciavalle, 'What is the best technical systems approach for the city? What standards do we need to apply? Are we delivering control systems in the best way? What was the most sustainable path forward to meet the business goals today and tomorrow? How do we protect ourselves from proposer price hikes (for parts and services) once we begin the project? '

The city chose the DBM (design, build, maintain) contract model,

Wastewater reclamation in Florida's Volusia County

A state-of-the-art automation system is helping a Florida wastewater treatment plant meet stringent standards for water reclamation and reuse.

The recently-expanded Southwest Regional Water Reclamation facility serving the City of DeBary includes a SIMATIC PCS7 automation and data monitoring system from Siemens Water Technologies. According to Dave Lee of Siemens, while SIMATIC PCS7 systems are in use automating critical operations like refineries and power plants, and many water and wastewater facilities around the world, this is the first application of the technology to be used in a wastewater treatment operation in the United States.

Operational for a year and a half, the system is helping the treatment plant monitor performance, track data, and prepare reports. 'Our operators have adapted well,' says Scott Heil, Volusia County Utility Operations Manager. 'It's really helped with our data collection and maintenance monitoring programmes.'

The Volusia County plant is designed to process an average flow of 1.7 million gallons (6.5 million litres) of wastewater a day. The treatment process includes bar screens for removing solids, an upflow sludge blanket filtration activated sludge system for biological treatment, including nitrification, tertiary filtration, and chlorine disinfection. Reclaimed water is used for irrigation of lawns and golf courses throughout the county, located along Florida's Atlantic coast south of Jacksonville.

Siemens has adopted the Profibus network communication protocol for its automation system, a feature that provides both simplicity and redundancy. The company's project manager Alex Figueiredo explains the technology allows the entire plant to run as 'plug and play', avoiding the myriad of wires and multiple PLCs common to older systems, while assuring system reliability. 'It's a hot standby,' he says. 'If one side goes down, the other takes over. One pair of redundant PLCs located in the main building runs the whole plant. You get a lot more capability, redundancy, and information for your money.'

Lee adds that the system simplifies system updates and modifications. 'You update a point once, and it is automatically disseminated throughout the entire programme.' This greatly reduces the chance for errors associated with custom programming on multiple PLCs and operator interface sites.

A screen shot from Volusia's plant control system which shows the status of the distribution pumps, and through which an operator can set up automatic control conditions for the pumps.

Siemens has also provided 3-dimensional imaging for the SCADA (Supervisory Control and Data Acquisition) screen displays, a feature that Heil and his staff say they appreciate. 'It's very useful for our operators to be able to see the entire process operation displayed graphically from a single location,' he says. A unique feature of this system is a 50-inch (127cm) monitor on the wall providing multiple 3-D graphics status view of the current process in a continuous 'marquee' style presentation.

The new system is also a big help with reporting, an important facet of successful water reclamation. Data generated automatically as well as entered manually can be folded into pre-formatted reports required by state water regulators, Figueiredo points out.

'Before, we had to go around the plant, gathering data and recording maintenance hours by hand. We had no way of retrieving old data,' says Heil. 'Now we can see what's happening in real time. We can gather and analyze data more readily. It's great for troubleshooting.'

which features a single purchase, with guaranteed pricing and performance. Competitive proposals were received from four potential vendors in 2009, with the contract awarded to Honeywell. 'The proposals were required to have unit prices for equipment, software and training, in effect for 15 years, to protect the city from predatory pricing,' says Perciavalle.

The new contract will integrate the city's existing computerized maintenance management system, and will include a fully furnished parts list and an interface to energy management systems, enabling operators to see energy use and cost of various operational options (peak and off-peak load electrical costs are a good example.)

An aerial view of the Hyperion wastewater treatment plant, Los Angeles, US. Credit: Google Earth.

The contract is also designed so that the city can keep pace with changing technology. 'Wastewater is always evolving, the footprint changing,' says Poosti. As an example, the gigantic Hyperion treatment facility, which opened in 1925 and started secondary treatment in 1951, continues to change in capacity and technology as the years go by. Honeywell is required to supply control systems upgrades as they become available, and at year 13, must completely refresh the system so that the city has state-of-the-art controls going forward.

What will happen

Under terms of the contract, Honeywell will remove all of the Bureau's DCSs over the next five to six years, replacing them with Honeywell field controllers and HMIs (human-machine interfaces) in the control room. Honeywell will also install an entirely new network backbone.

A new fibre optic network will be routed through every plant and connected back to a central control room that the city will construct at Hyperion.

Honeywell will field-verify hundreds of thousands of existing wire termination points, consolidating and minimizing them and eliminating a number of electrical cabinets. 'The current system is not well documented,' Poosti notes.

Honeywell will also supply new consoles, electronics and servers, and patch in wide area networks.

But the company will provide more than just technology, Haslam explains. Honeywell will invest in training programmes both at the site and in the larger community. 'We are planning to develop training centres at local colleges and technical schools,' she says. 'The next generation of operators and control specialists will be able to replicate the Hyperion system, try out control strategies, and perform intelligent analyses. Knowledge transfer is essential to success.'

Timing and cutover

The notice to proceed on the contract was issued in December, so schedules are still being prepared. Perciavalle explains that once the controls for a particular system or unit process are in place, the cutover to the new technology will be accomplished via a stepped approach, taking advantage of

the redundancy in the treatment processes. 'We anticipate taking down one unit within a specific system, converting it to the new control platform, and then putting it back into operation and taking down the next unit,' says Perciavalle. 'We don't anticipate any "hot" cutovers.'

The existing schedule calls for change out of the Bureau's collection system first, with the cutover process beginning in March 2013, and being completed by April 2014. Cutover dates for the Hyperion and Terminal Island treatment facilities are December 2015 to February 2017. Conversion of the controls at the two remaining treatment plants will follow at later dates.

'As we convert to Honeywell,' Perciavalle explains, 'one operator will be working with the new Honeywell system, while another works with the old system, until the system is 100 percent converted. For a while, we'll have two active control rooms.'

Teamwork

In a project as complex and far-reaching as this one, communications and teamwork are critical. That is why the Bureau and Honeywell have laid out a plan to literally work hand-in-hand as the new system is designed and installed.

'It's very important that we all be on the same page with something this complex,' says Perciavalle. 'We'll be essentially working together with Honeywell, CH2MHill, and Bureau of Sanitation people occupying a common office space at the Hyperion plant. Perciavalle says this approach is much better than having the Los Angeles project team frequently flying to Honeywell's office and vice versa.

Poosti points out that the Bureau's project team includes experts from the city's engineering staff, operations group, contract administration, schedulers and estimators – about 15 people in all.

Haslam says Honeywell's team is already on the ground, validating design assumptions and hiring subcontractors. She says the company will be able to capitalize on the significant number of Honeywell control and automation specialists now in the Southern California area as well as tap into the firm's global expertise.

'Our automation systems serve most of the refineries in the Los Angeles area,' she explains, 'so we have a strong local presence.' In fact, she adds, many Honeywell employees are customers and rate payers in the Los Angeles system, noting that improving the efficiency of the city's wastewater collection and treatment will take on a special meaning.

'We're approaching this project as a partnership, and as far as long-term benefits go, I think we've just scratched the surface.' ●

LA Bureau of Sanitation

Treatment plants

- Hyperion: treats 350MGD (1330MLD) / capacity of 450MGD (1710MLD)
- Tillman Water Reclamation: treats (67MGD (255MLD) / capacity of 80MGD (304MLD)
- LA / Glendale: treats 20MGD (76MLD) / capacity of 20MGD
- Terminal Island: treats 17.5MGD (66.5MLD) / capacity of 35MGD (133MLD)

Customers

- 4 million
- 29 contract agencies and cities

Collections

- 6700 miles (10,720km) of sewers
- 65 pumping stations

Biosolids

- More than 700 dry tons (630 tonnes) a day
- Composting, land application and deep well injection for renewable energy.

California water districts automate

● Systems provider Forshock has been working with water districts in California, US, to lower energy use, improve system efficiency and increase supply safety.

As in many areas of the world, water districts and municipalities in California must meet growing demand with limited supply, putting more stress on the water distribution infrastructure.

Southern California in particular places a high priority on investments in maintaining and upgrading water supply infrastructures, due in part to its desert climate. Automation is a necessary part of that investment as it enables water districts to lower costs, reduce energy use, operate more reliably, and reduce maintenance and downtime.

One water district in the area, Mission Springs, has upgraded its pump station and reservoir controls at multiple sites to meet energy and reporting requirements, working with systems integrator Forshock to implement a range of control systems.

'Having the ability to remotely control and monitor VFDs (variable frequency drives) allows us to adjust settings to maintain operation pressures and setpoints,' notes Richard Johnson, water production supervisor at Mission Springs Water District. 'The inclusion of on-site intrusion detection allows us to monitor potential threats to our customers' water supply.'

Before upgrading pump station controls, frequent trips were required to check status. Remote monitoring has eliminated most of those visits, and the video surveillance system provides detailed information about pump station conditions and operation, further reducing required trips to the site.

Mariana Ranchos County Water District

Forshock has also been working with Mariana Ranchos County Water District in Apple Valley, California to reduce costs and increase efficiency by upgrading the pump station controls. The water district now controls and monitors its three pump stations and two booster stations with AutomationDirect Model DL06 PLCs. The human-machine interface runs Forshock's SCADAspire software on a PC.

Time-of-Use is one of the most important SCADA features for pump station applications at the water district. 'Without this one feature, we would be spending three times as much on our electric bill,' notes James Hansen, general manager of Mariana Ranchos County Water District. 'We can control by time or by level. You can match each tank or reservoir to each pump station with great flexibility.'

Mission Springs Water District upgraded its pump station controls to increase security, reliability, energy efficiency and reporting capabilities. Credit: Forshock.

The Time-of-Use feature uses the system's internal real-time clock to allow water district operators to create schedules for weekdays and/or weekends to prevent pumps from operating during preset times. This lowers the risk of accidental startups, which can incur additional costs if pumps operate during peak local electrical utility demand hours.

Combining low cost PLCs with standards-based communications systems and PC-based HMIs results in an overall automation system that provides value and reliability, says Forshock. ●

Adapted from an article by Mike Crabtree.

Improved reliability for Dutch water transmission system

● To ensure the reliability of Dutch water company Evides' water transmission system that carries water 130km across The Netherlands as major upgrades were put in place, Royal Haskoning undertook hydraulic modelling of the system. After a year in service, the new system has successfully operated as expected.

Map of Evides' water transmission system.

Raw water from the Meuse River, held in storage basins in the Brabantse Biesbosch region, is supplied to the Dutch province of Zeeland and the region of Zeeuws-Vlaanderen through a 130km long transmission main, where it is used for drinking water, industrial use and agriculture.

An increase in demand and the need to improve system reliability prompted the Evides Water Company to upgrade this transmission system with new parallel transmission mains. The pipe system carries around 70,000m³ of water, so in 2010 Evides and consultant Royal Haskoning carried out a hydraulic study, which including looking into the risks of pressure surges (waterhammer) to the system.

In the old situation, the pumping station at Evides Petrusplaat pumped water from the storage reservoir via the pipeline system. Booster pumping station Wouw increased the pressure to ensure sufficient water pressure at Bath, Kraaijenberg and other locations, whilst booster pumping station Bath supplied water to industrial and agricultural users in Midden-Zeeland. The Kraaijenberg pumping station supplied water via the booster pumping station Vogelwaarde to various locations, including the Deco plant used by Evides, to produce various qualities of process water for the Dow Chemical Company. The final point of supply is the drinking water treatment plant Braakman at Zeeuws-Vlaanderen.

The major change to the system is pumping station Petrusplaat and booster pumping station Wouw will be pumping directly to the endpoints without utilizing the intermediate pumping station Kraaijenberg and Bath. The total length from Petrusplaat to Zeeuws Vlaanderen is 110km (excluding 20km to Midden Zeeland). The total supply flow rate is 5100m³/h of which up to 2000m³/h goes to the new process water treatment plant (PWTP) and 1800m³/h to Midden Zeeland.

Royal Haskoning utilized the software package 'Wanda' from Deltares to determine the necessary parameters for pumps and valves to ensure customers received sufficient water at an acceptable pressure. Extreme flow variations were also tested, including changing the maximum flow rate variation to Midden Zeeland, from 800m³/h to 1800m³/h and vice versa, and the flow rate to the process water treatment plant from 400 to 2000m³, to ensure the system was functioning as it had been designed to.

A year after the commissioning of the pipe system in January 2011, indications are that the system is functioning as originally envisaged by the designers. All seasonal demand fluctuations have also been taken into consideration during the one-year period after commissioning.

The innovative combination of hydraulic computer models incorporating measuring and control components used by Royal Haskoning has resulted in a stable system with benefits both for the operator and the various consumers. ●

Adapted from an article by Leon Mecksenaar, Jo Arens and Ed Holierhoek.

Siemens supplies complete control for Poland's largest wastewater plant

Poland's largest wastewater treatment plant, due to be completed at the end of this month, is being built in the capital, Warsaw, to treat the city's wastewater and improve the quality of the river Vistula that flows through it, which is an important source of drinking water.

The Czajka wastewater plant will treat the wastewater from around 2.1 million inhabitants of Warsaw's metropolitan area. Alongside the new plant a new central sewer will also be built to carry wastewater from the rest of the city under the Vistula to the Czajka plant, which includes a thermal processing plant that generates power and heat from wastewater sludge.

Automation of the thermal sludge processing is based on Siemens' Simatic PCS 7 process control system – as is the rest of the automation in the wastewater treatment plant, so all plant components benefit from standardised architecture and use a uniform engineering library.

In the future, all plant information, from incoming wastewater to the outlet, will be shown both at the central control station of the thermal sludge processing plant and in the control centre of the wastewater treatment plant. This gives personnel an overview of all the processes at all times. In the final installation, the data from the process will be captured by more than 60 Simatic PCS 7 automation systems, which are networked with the process instruments and analysis devices via Profibus.

'These measuring devices, which were developed especially for wastewater plants, can be found in nearly all processes in the plant,' explains Marcin Masek, process instrumentation manager at Siemens in Poland. 'More than 200 Sitrans flowmeters, more than 100 MultiRanger fill-level measuring devices and Pointek level switches and numerous Ultramat gas analyzers are installed in the plant – from the pump stations to the biological treatment and sludge conditioning to the thermal sludge processing.'

Aeration of the wastewater using Siemens' Sitrans process instruments. Credit: Siemens.

Siemens has also supplied a large part of the low-voltage power supply and drive technology. ●

Adapted from an article provided by Siemens Industry Automation.

Sustainable groundwater use for developing country urban populations: lessons from Brazil

Rapid urbanisation in Brazil has led to heavy reliance on groundwater supplies, and as city growth has outstripped water supply and sanitation coverage, private wells are an important component of water supply. **STEPHEN FOSTER** and **RICARDO HIRATA** discuss the challenges surrounding urbanisation and sustainable groundwater management, including self-supply from private wells, using the example of Brazil's expanding urban population to show how groundwater reserves in developing countries can be secured to provide a safe, long-term water supply.

The 2010 census of Brazil revealed that 84% of the population of 191 million are urban dwellers – with some 77 million living in 100 cities of more than 0.25 million inhabitants. However, rapid urbanisation and steady economic growth in recent decades have not generally been accompanied by parallel rates of investment in water supply and sewerage infrastructure. Overall, these services reach only 79% and 44% of urban dwellers respectively.[1]

In larger metropolitan areas surface water is usually the major source of water supply, but it often has to be transported over considerable distances from outside the immediate watershed through increasingly complex and costly systems. But where cities are located close to highly productive aquifers (e.g. Natal, Ribeirão Preto, Belém, Maceió, Recife and Porto Velho) water service utilities depend heavily upon groundwater, and it is the sole source of mains water supply for 39% of urban municipalities. Elsewhere, utilities use groundwater as a complementary source, especially to supply peri-urban neighbourhoods. Thus, groundwater plays an important role in the public water supply of 52% of urban municipalities (equivalent to about 35% of the urban population) by means of 430,000 wells, with some 10,800 new wells per year, predominantly in small- to medium-sized towns.[2]

What is equally significant, but rarely acknowledged, is the phenomenon of private self-supply from groundwater, which widely represents a significant proportion of the water supply received by urban residential, commercial and industrial users.[3] Moreover, some major cities (e.g. São Paulo and Brasilia) have public water supply systems operating at the limit of their capacity and any increase of production will require major capital investment for surface water transfer from distant watersheds. In such cases, private wells form an important component of supplying additional demand and currently underpin water supply security.

Threats to groundwater use sustainability

Groundwater and urbanisation are intimately linked (Figure 1). Inadequately controlled groundwater abstraction can deplete aquifers, but the effect of urbanisation processes on the volumetric rates of local groundwater replenishment (and thus resource availability) can often be positive, due to recharge from water main leakage.[3] However, the widespread existence in urban areas of (potentially controllable but often still uncontrolled) contaminant discharges from leaking sewers poses a serious threat to groundwater quality, whose impact varies widely with natural aquifer pollution vulnerability.[3]

Thus, urban groundwater use sustainability is influenced by a complex array of interrelated decision making, which is rarely viewed on an integrated basis, but includes:

- Well drilling and use authorisation (by state-level government agencies)
- Provision of water supplies (by water utilities)
- Urban land use planning and authorisation (by municipal government offices)
- Installation of sewered sanitation (by water utilities)
- Disposal of liquid effluents and solid wastes (by environmental authorities, public health departments and water utilities).

Policy and management issues

The main issues related to urban groundwater use are summarised in Table 1.

Integrating groundwater into urban land and water management

There are numerous simple practical measures that could be undertaken as necessary by public administrations to improve the sustainability of groundwater use, including:

- Declaration of 'critical areas' where groundwater extraction must be constrained for the 'common good', through specific bans or conditions on new or replacement wells
- Prioritisation of selected recently urbanised districts for mains sewer coverage to protect their good quality groundwater from gradual degradation, and limiting the density of new urbanisation served by in-situ sanitation to contain groundwater nitrate contamination
- Establishment of groundwater source protection zones, around all utility wells that are favourably located to take advantage of parkland or low-density housing areas
- Imposition of better controls on the handling and disposal of industrial effluents and solid wastes to reduce the risk of aquifer pollution

In addition, and most importantly, the establishment of water utility wellfields outside cities (with capture areas being declared as ecological or drinking water protection zones) needs to be promoted as 'best engineering practice'. In the past the development of such wellfields has rarely occurred – because they are either not conceived as beneficial or because of administrative impediments related to fragmented powers for land use and pollution control, and between the numerous municipalities that comprise 'metropolitan areas'. These need to be addressed and it should be possible for procedures and incentives to be identified where the groundwater resource interest of a given urban municipality can be assumed by a neighbouring rural municipality, so that adequate protection to such investments can be provided.[3]

Given the continuous evolution of groundwater use in urban aquifers, and the significant hydrogeologic uncertainty in predicting its precise behaviour, it is desirable to adopt an adaptive management approach to urban groundwater resources – based on the continuous monitoring of groundwater levels and quality, and guided by a periodically updated numerical aquifer model. This could be used for evalua-

tion of future scenarios and to facilitate the definition of 'capture zones' for public wells that require protection and / or for the identification of the most suitable areas for 'external wellfield' construction.

Promoting conjunctive use for water supply security

Groundwater and surface water present complementary characteristics and, as far as feasible, should be used conjunctively to overcome urban water supply problems and improve urban water supply security. Although 13% of Brazilian cities use both resources for public water supply, this has (for the most part) not been planned in an optimal way. Most commonly, utilities only construct new wells for base-load supply operation, especially in newly urbanised peripheral zones. The possibility of using natural groundwater storage across entire urban areas to provide greater water supply security during droughts is generally overlooked.

Moreover, municipal water utilities tend to focus mainly on well engineering and (with a few notable exceptions) have shown little interest in understanding and managing the local resource base – thus the criteria for well siting usually relates solely to meeting immediate water supply requirements at minimum cost and do not consider the optimal use of groundwater resources. This must change to meet future urban water supply challenges.[4]

Private groundwater use – maximising benefits whilst minimising risks

The initial investment of private capital for in-situ urban self-supply from groundwater is usually triggered during periods of partial failure of (or highly inadequate) water supply services, essentially as a 'coping strategy', but it is continued by some users after the supply improves, as a cost-reduction strategy, since the unit cost of groundwater to private well users is lower that the applicable municipal water supply tariff.[3] Also, many private well operators do not consistently account for their running costs, and on the outskirts of many cities public water supply coverage may not yet be available, and private groundwater use may be the only feasible alternative.

A broader assessment of urban well use practices is thus required by public administrations to formulate a balanced policy on private groundwater resource use (Table 2). If this assessment indicates serious hazards from groundwater pollution or overexploitation, the following management actions could be considered (as appropriate to local conditions):

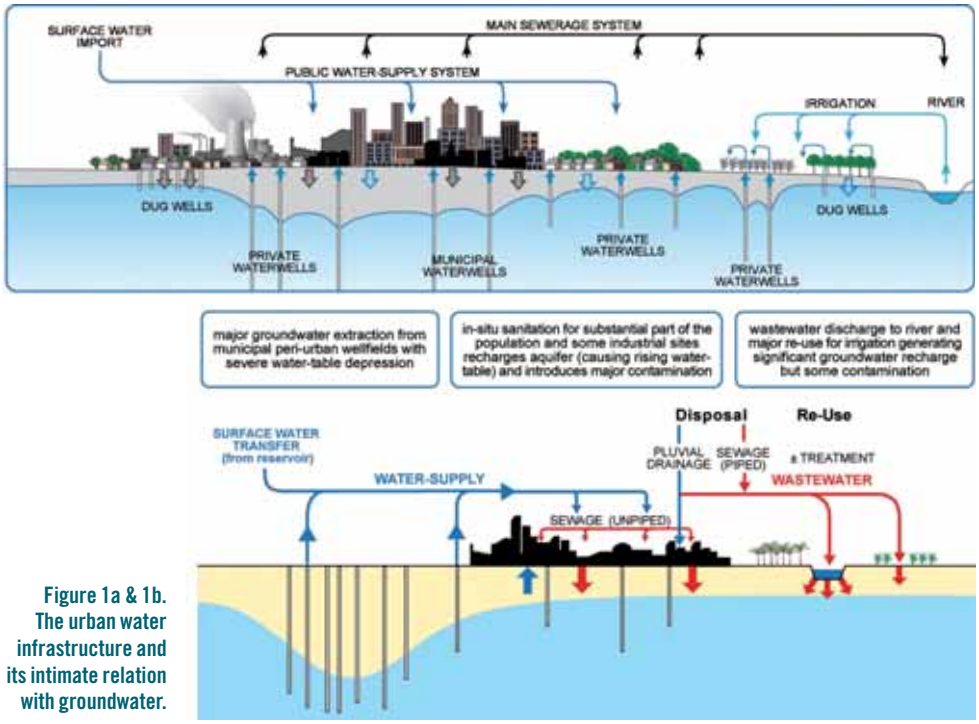


Figure 1a & 1b. The urban water infrastructure and its intimate relation with groundwater.

- Registering all multi-residential, commercial and industrial users (directly by metering or indirectly by estimated sewer discharge) for abstraction charges, so as to constrain use
- Issuing of water quality advice and / or health warnings to private well operators, and in severe pollution situations declaring sources unsuitable for potable and sensitive uses

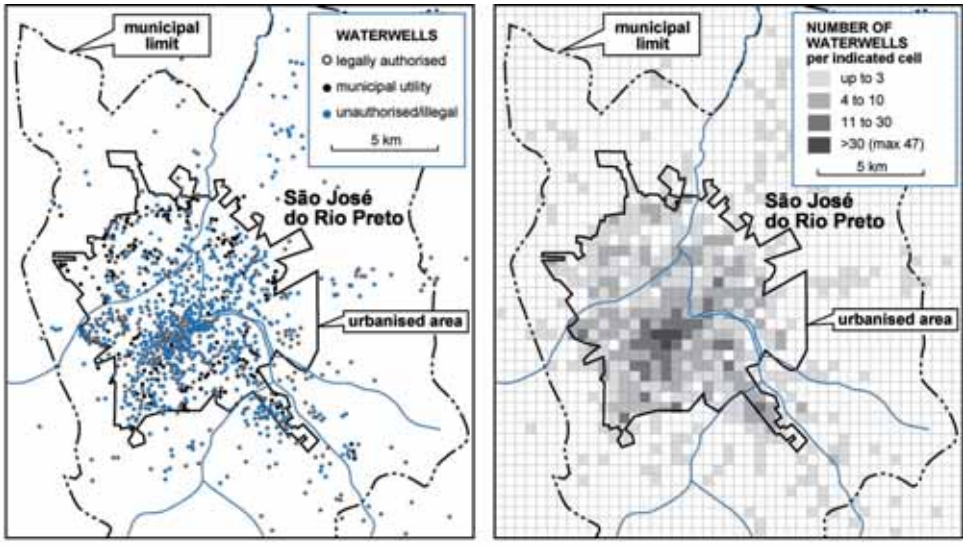
An important emerging policy question is under what circumstances the risks or inconveniences of private residential self-supply from groundwater in the urban environment might justify an attempt to ban such practice completely. Historically, urban private well use bans (or severe constraints) have been necessarily introduced as part of an effort to address the control of a specific waterborne disease outbreak (e.g. cholera in 19th Century London or in some Caribbean ports in the 1980s), or land subsidence and increased flood risk due to excessive groundwater abstraction (e.g. Bangkok and Jakarta since the 1990s).

In Brazil, groundwater abstraction constraints are currently imposed in specific zones of Ribeirão Preto and São José do Rio Preto (both in São Paulo State) to address problems of local overexploitation and continuous aquifer depletion (Figure 2), but the restrictions apply to all classes of use. In São Paulo City use constraints are in place for zones of (known to be hazardous) industrial groundwater contamination, but attempts have been made to keep most existing wells functioning, since complete replacement by mains water supply is not possible.

Private well use in urban areas poses a difficult challenge for water resource agencies in developing nations.[3] Modern well drilling techniques provide rapid access to groundwater for modest capital investment, making possible the existence of large numbers of users whose 'hardware' is soon hidden from view. To date, effective management of this situation has often been beyond the capacity of public administrations. Most private wells are thus at best unregulated and at worst illegal – which in the longer-run benefits neither the public administration nor the private user. To address this situation it will require the strengthening of the professional capacity and political mandate of water resource agencies, with judicious use of sanctions, but with the greatest emphasis on gaining civil society commitment through effective participatory mechanisms with incentives for self-monitoring.[5,6]

Concluding remarks

The importance of groundwater for urban water supply in Brazil is not yet reflected by sufficient investment in the management and protection of the resource base. Government, at all levels from municipal through state to federal, need to seek realistic policies and effective institutional arrangements to address these issues, and they will require the support of the political leadership, improved communication with and participation of stakeholders, and to be informed by sound hydrogeological science to meet this challenge.



GROUNDWATER CONTROL ZONE	WATER RESTRICTIONS
Low	new wells permitted (>600m distance from any public water-supply well)
Moderate	only new public water-supply well permitted
High	only replacement public water-supply wells permitted

Figure 2 : Groundwater restriction zones based on waterwell density in São José do Rio Preto.

In Brazil, state water resource agencies and river basin stakeholder committees are in the process of development nationwide, and the latter must be the initial forum for the necessary dialogue to improve the incorporation of groundwater resources into watershed planning generally. However, the members of such committees rarely have enough knowledge of groundwater issues or system behaviour and could reasonably be expected to delegate action to a specialist support group.[6] In this context the dynamics of urban development and its intimate relation with groundwater are such as to merit the formation of specifically-funded urban groundwater consortia for larger cities (involving the municipal government land use department, state government groundwater resource agency, the water service utility, local environment and public health departments, water user representatives and groundwater specialists from academia).

It is believed that the issues and approaches described in this article will find immediate resonance in the urban areas of numerous other countries in Latin America and South and East Asia, and increasingly in the future in Sub-Saharan Africa.●

Acknowledgements

The authors wish to generally acknowledge extensive dialogue with many groundwater specialists around Brazil in their work on urban groundwater use. The article is in part a by-product of a review of urban groundwater use policy issues by the World Bank GW-MATE (Groundwater Management Advisory Team) for ANA (Agência Nacional de Águas), but it must be stressed that the opinions expressed are those of the authors alone and do not necessarily reflect the position of those organisations. However, the authors wish to especially thank the following for important discussion and / or valued encouragement: Paulo Varella and Fernando de Oliviera (ANA) and Alexandre Baltar and Paula de Freitas (World Bank-Brasilia).

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Table 1. Summary of the major policy issues associated with urban groundwater

Issue	Implications
Municipal water supply benefits	Groundwater use for municipal water supply has many benefits (including capacity to phase investments with demand growth and high quality requiring minimal treatment) but it usually comes with a need for integrated planning of urban land use, effluent discharges and solid waste disposal to avoid insidious and near irreversible degradation by pollution.
Protected municipal wellfields	Since some degradation of groundwater quality in urban municipal wells due to persistent pollutants is likely, it is necessary in parallel to develop 'external wellfields' and declare their capture areas as 'protected zones' to guarantee that a proportion of the total resource is of high quality and available for dilution or substitution.
Conjunctive use with surface water	The rates of replenishment of aquifers may not be sufficient to meet the demands of larger cities sustainably, and in this situation it is preferable to use available groundwater resources and large storage reserves conjunctively with surface water sources – conserving groundwater for use during drought and other emergencies.
Private in-situ use benefits & hazards	Private in-situ use for urban residential, commercial and industrial water supply can have significant benefits not only to the user but to the community (reducing demand on utility supplies, providing water in areas or volumes difficult for the mains network, not using high quality mains water for garden irrigation and commercial / industrial cooling). These benefits need to be valued in terms of the marginal cost of providing a volumetrically equivalent alternative water supply – but poorly constructed and shallow urban wells can present a significant health hazard due to faecal contamination (in serious waterborne disease outbreaks) or chemical contamination (especially in areas without mains sewerage).
Water sector financial considerations	Widespread self supply can have major financial implications for water utilities, in terms of loss of revenue from potential water sales, difficulties of increasing average tariffs and recovering sewerage charges from those operating private wells.
Future drainage problems	Should abstraction radically diminish (due to an increased offer of subsidised mains water supply or to quality deterioration or pollution rumours), groundwater levels will rise progressively to higher than the pre-urbanisation condition, potentially with serious sanitary problems and infrastructure damage in lower lying areas.

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Table 2 : A public administration overview of the pros and cons of private residential in-situ urban water supply from groundwater

Pros

Greatly improves access and reduces costs for some groups of users (but not generally for the poorest because without help they cannot afford the cost of well construction except in very shallow water-table areas).

Especially appropriate for 'non quality-sensitive' uses – could be stimulated in this regard to reduce pressure on stretched municipal water supplies.

Reduces pressure on municipal water utility supply and can be used to meet demands whose location or temporal peaks present difficulties.

Incidentally can recover a significant proportion of mains water supply leakage.

Cons

Interactions with in-situ sanitation can cause a public health hazard and could make any waterborne epidemic more difficult to control, and also potentially hazardous where serious natural groundwater contamination is present.

May encounter sustainability problems in cities or towns where the principal aquifer is significantly confined and / or mains water supply leakage is relatively low.

Can distort the technical and economic basis for municipal water utility water operations with major implications for utility finance, tariffs and investments.

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About the authors

Stephen Foster has wide experience of groundwater management and protection in the EU and worldwide. He served as World Health Organisation-Groundwater Advisor for Latin America & Caribbean during 1986-89, World Bank-Groundwater Management Advisory Team (GW-MATE) Director during 2001-10, and is International Association of Hydrogeologists (IAH) Immediate Past President.

Ricardo Hirata is Professor of the University of São Paulo, Brasil and Director of the Groundwater Research Center (CEPAS). He has very extensive experience of groundwater evaluation and protection throughout Latin America and was a member of World Bank GW-MATE.

Project INCOME: developing a comprehensive approach for Slovenian aquifer management

In an effort to combat deteriorating groundwater quality in two aquifers supplying Slovenia's capital city, the project INCOME was set up to develop new monitoring and remediation tools to improve the management of these groundwater resources. As the project nears its conclusion, **BRIGITA JAMNIK, MITJA JANŽA** and **JOERG PRESTOR** look at how INCOME's solutions are being put into practice.

The main source of drinking water in Slovenia is groundwater – 97% of the country's population depends on groundwater for its water supply. The Ljubljansko polje and Barje alluvial aquifers, exploited for the public water supply of Ljubljana, the capital city of Slovenia, are among the most important. They are characterised by a strong interconnection of surface and groundwater, a high vulnerability, and high velocities of groundwater flow and pollutant transport.

Not only is a long-term stable and safe water supply in Ljubljana the primary goal of the water supplier, JP Vodovod-Kanalizacija, the leading partner of the INCOME project, it is also the project's main focus. Financially supported by LIFE+, EU's funding instrument for the environment, the Municipality of Ljubljana, and the Ministry of the Environment and Spatial Planning of Republic of Slovenia, the INCOME project started in January 2009 and is now in its final phase, which will conclude at the end of June 2012.

Anthropogenic conditions in the catchments of the aquifers are characterised by the significant pressures of urbanisation, industry, traffic, agriculture and old environmental burdens. Unknown pollution sources are a serious challenge to groundwater quality, which is deteriorating in spite of basic measures and strict environmental legislation.

Due to the wide range of potential threats to and the dynamics of groundwater systems, legislation has proven to be lacking in adaptability and flexibility when dealing with these problems. The patchwork of policies, regulations, programmes and guidelines that generally concern groundwater protection issues and the multitude of agencies involved at all levels of legislation are especially discouraging. Natural conditions require a fast administrative response, timely decisions and adequate measures. In case of sudden pollution, reactions should be very fast to avoid serious impact to the water supply. With a mostly widely-spaced monitoring well network and limited sampling, the present standard monitoring approaches bear a high risk of not detecting contamination events. Therefore, new investigation, monitoring, remediation and administrative tools as well as a combination of tools have been investigated within the INCOME project.

Improving groundwater monitoring

The establishment of the register of potential and actual polluters, created by the Anton Melik Geographical Institute, and a detailed overview of the chemical status of the groundwater put together by the Geological Survey of Slovenia (GeoZS), were two of the project's most important early milestones. The results of these activities were the basis for the planning and construction of seven deep (48 to 122m) observation wells for groundwater quality and level measurements in the Ljubljansko polje area, and 31 shallow (up to 30m) observation wells to control the upper part of the aquifer of Ljubljansko barje. The new observation wells have made up for the shortage of appropriate monitoring sites necessary for the timely detection of potential threats to the drinking water supply. The direct push technology, used by the German INCOME partner Fugro Consult GmbH (formerly geo-log) for the construction of shallow wells, was successfully applied for the first time in Slovenia.

The knowledge of aquifer characteristics has been additionally improved by tracer experiments and periodical sampling for chemical and isotope analyses. A new method of passive sampling and analytical laboratory techniques were developed at the Technical University of Darmstadt, Germany, proving that environmental forensics is a useful tool in determining traces of volatile organic hydrocarbons and their origin. The gathered information has been included in an environmental database that is accessible to the public through a website (http://akvamarin.geo-zs.si/incomepregledovalnik) developed as the basis for a hydrological model and a model of environmental pressures and impacts by GeoZS.

Decision support

The problems in water management are complex – an interdisciplinary approach is often necessary and solutions must be reached under strict time constraints. In such circumstances decision support systems (DSS) are a beneficial tool that can help decision makers to choose the right long- or short-term measures, e.g., in the process of land use and spatial planning in water protection zones or in the case of environmental accidents. As a result, in the frame of the INCOME project, one such DSS has been developed by GeoZS as a lead partner.

The developed DSS is an interactive computer system that utilises a database, hydrological modelling, and experts' and stakeholders' knowledge, which is updated with the information acquired in the frame of INCOME project. It consists of three components, tackling the different above-mentioned issues in water management. The first utilises the work on identification, cleaning up and restoration of illegal dumpsites that are a serious threat to the qualitative status of groundwater. The other two components utilise the predictive capability of the hydrological model and scenario analysis. The user interacts with the system through a graphical interface that guides the user step-by-step to the recommended remedial measures. Consequently, the acquisition of information to support the water management's decisions is simplified and faster, thus contributing to more efficient water management and a safer supply of drinking water.

In the 'INCOME after INCOME' period the project group has set itself a demanding task: to present the benefits of the established INCOME tools and proposals to potential users and to spread the INCOME ideas to the entire Slovenian territory and even beyond its borders, to places where aquifers are situated below urbanised areas.●

For more information, visit: www.life-income.si.

About the authors
Brigita Jamnik is Head of INCOME project at JP Vodovod-Kanalizacija. Mitja Jan?a is a Researcher in the Department of Hydrogeology, Geological Survey of Slovenia. Joerg Prestor a Researcher in the Department of Hydrogeology, Geological Survey of Slovenia.

Ensuring efficiency in geothermal systems: *reducing costs with regular maintenance*

Although geothermal systems can be very efficient for heating and cooling of buildings, the problem of mineral and bacterial contamination in the groundwater source can cause serious system failure. **MIKE DEED** outlines the need for regular maintenance of geothermal systems to control bacterial growth and keep systems running efficiently.

As much as 40% of an organisation's annual energy budget is spent on heating and cooling so it is no surprise there is growing interest in geothermal solutions for commercial applications. Geothermal systems are one of the most efficient heating and cooling systems available – for every 1btu (British thermal unit) of electricity used, a geothermal heat pump unit produces 3-5 btus, making it 300 to 500% more efficient than using electric resistance heat and 20 to 30% more efficient than typical boiler / tower systems. It is estimated that cost savings of up to 70% can be achieved and, more importantly up to 50% reduction in carbon dioxide emissions.

Geothermal systems fall broadly into open loop and closed loop categories. Open loop systems abstract groundwater from one or more sources and heat is either extracted or added by the primary refrigerant loop, and the water is then returned to a separate well or body of water. Open loop systems are particularly attractive because they are simpler to install, there is less heat transfer loss and heat pump energy costs are generally lower.

For an open loop system to work effectively it needs a large supply of clean water and one of the biggest problems is mineral and bacterial contamination in the groundwater source. Iron bacteria and iron oxide contamination is estimated to affect about 40% of the world's water bores and whether caused by naturally-occurring bacteria or straight chemical means, anecdotal evidence indicates this number is steadily increasing. The bacteria and associated residues can build up inside the heat exchanger, clog both the abstraction and recharge wells and increase the friction losses in the flow section of the system. Ultimately this reduces output, wastes energy, increases operating costs, and ultimately compromises the original reason for opting for geothermal energy. Whilst iron oxide residues can be completely removed it is impossible to completely eliminate iron bacteria and minimising their growth is the only way of controlling the problem.

Consequences of a clogged system

In 2008 in Lodi, Italy, a geothermal plant was installed to service an air conditioning system for the District Council offices. The system was designed with an overall thermal power of 0.6MW, achieved by one heat pump with heat exchangers, a 42m deep abstraction well, a 29m deep recharge well and 100m of pipework. The system ran into immediate problems as blockages in the recharge well were causing flooding in adjacent areas and the system had to be switched off for rehabilitation. A second screen was installed and the system was cleaned with hydrochloric with poor results. The system was used the following year but the blockages remained and the flooding continued.

In October 2009 water management and ground source energy specialist ESI was consulted to find a solution as iron bacteria growth was suspected. A video inspection of the system by Millars Products, Italian rehabilitation specialists and partner of UK-based Geoquip Water Solutions, showed that both wells were completely clogged with iron bacteria and iron oxide residues. The slots in the screens in the recharge well were completely sealed, preventing the discharge of purged water into the ground.

Iron oxide on pump removed from well

BoreSaver Ultra C Pro from Geoquip was used to treat the system, which disrupts and dissolves iron bacteria cells and the associated iron oxide residues, whilst the BoreSaver components are converted to carbon dioxide and water. A post-treatment video inspection revealed that the screen slots were virtually clear of contamination and the system worked efficiently through the summer without subsequent borehole clogging.

Towards the end of 2010 however, levels in the recharge well were once more increasing and it was evident that on-going maintenance needed to be implemented to control the contamination of iron bacteria. Millars Products returned in May 2011 to effect this and, using BoreSaver, returned the system to full operational use.

The Lodi case study demonstrates the importance of having an effective monitoring and maintenance programme when using a geothermal system. It is likely that the continuing severe contamination from iron bacteria in the recharge well was due to the fact that the entire geothermal system was not cleaned, allowing for recontamination.

In virtually all studies evaluating the use of geothermal systems, low maintenance costs are identified as one of the key benefits. However these low maintenance costs depend on businesses appreciating the importance of monitoring a geothermal system to ensure maximum flow rates are achieved. Regular proactive maintenance always proves to be most cost effective in the long run and businesses are urged to build in a programme and a cost element for this aspect when considering renewable energy sources. ●

About the author
Mike Deed is the owner and Managing Director of Geoquip Water Solutions. Email: mike@geoquipservices.co.uk

Figure 1: Following the BoreSaver clean in May 2011, the graph shows the drop in the dynamic water level and the subsequent control of the level to allow effective discharge of the purged water

Cause and prevention of abstraction well clogging: diagnosing potential supply problems

● A significant amount of groundwater worldwide is abstracted from wells, but blockages can occur due to chemical or sedimentary reasons. **KEES VAN BEEK** discusses the processes of how clogging can occur, and why it is necessary to understand the type of clogging taking place in order to put in place the correct preventative measures.

In sedimentary deposits (river plains) all over the world there are millions of wells abstracting groundwater. Abstracted groundwater serves many purposes, such as the production of drinking water and beverages, and in agriculture for irrigation and cattle watering. Groundwater abstraction in itself serves many purposes in civil engineering, like dewatering of building and mining sites, slope stabilization, and stabilization of dikes and dams. Currently, groundwater is also increasingly being abstracted for supply and storage of energy for cooling and heating of buildings.

A great number of these wells do clog after time. It is possible to rehabilitate these clogged wells, but after several blockages they often have to be replaced by new ones. This rehabilitation and replacement has its costs.

Clogging becomes most pronounced during critical periods – in summer when water demand is at its maximum and water levels at their lowest, or after rainy periods when water levels behind dams are at their maximum, as is seepage. In this way, clogging also endangers a well's operational reliability.

Obviously, it is better for operational reliability if well clogging can be prevented, and ways to do this have recently become available. However, be careful. There are two types of well clogging, and the two methods of prevention are opposites. This difference stresses the need for a correct diagnosis of the cause of well clogging.

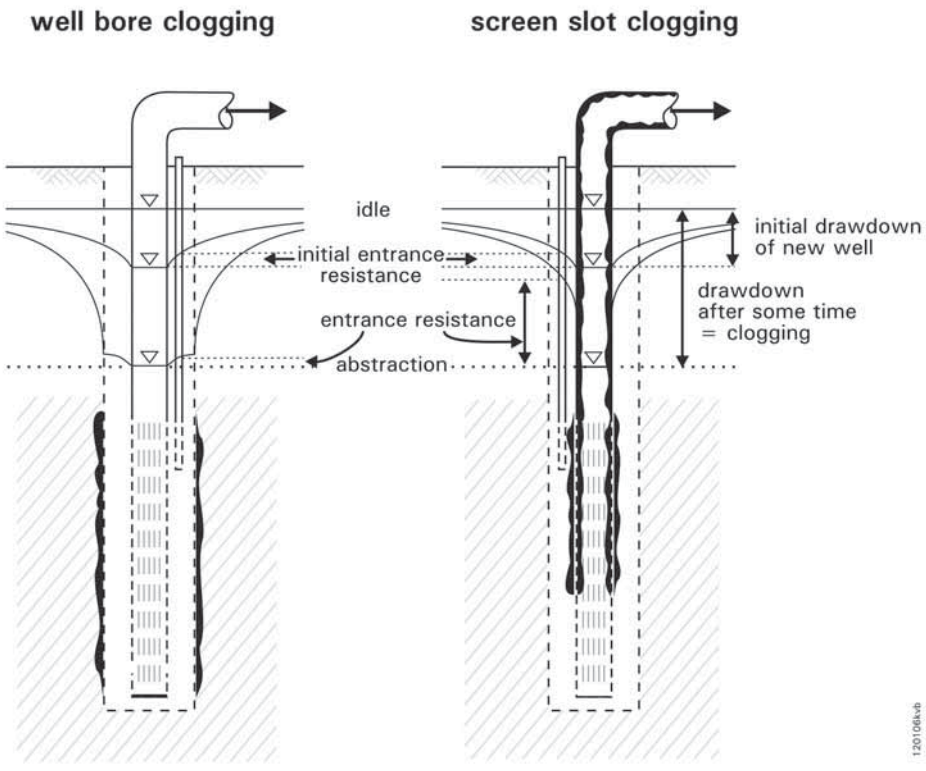


Figure 1: Differences in behaviour of entrance resistance: nearly absent in well bore clogging (left) and growing in screen slot clogging (right).

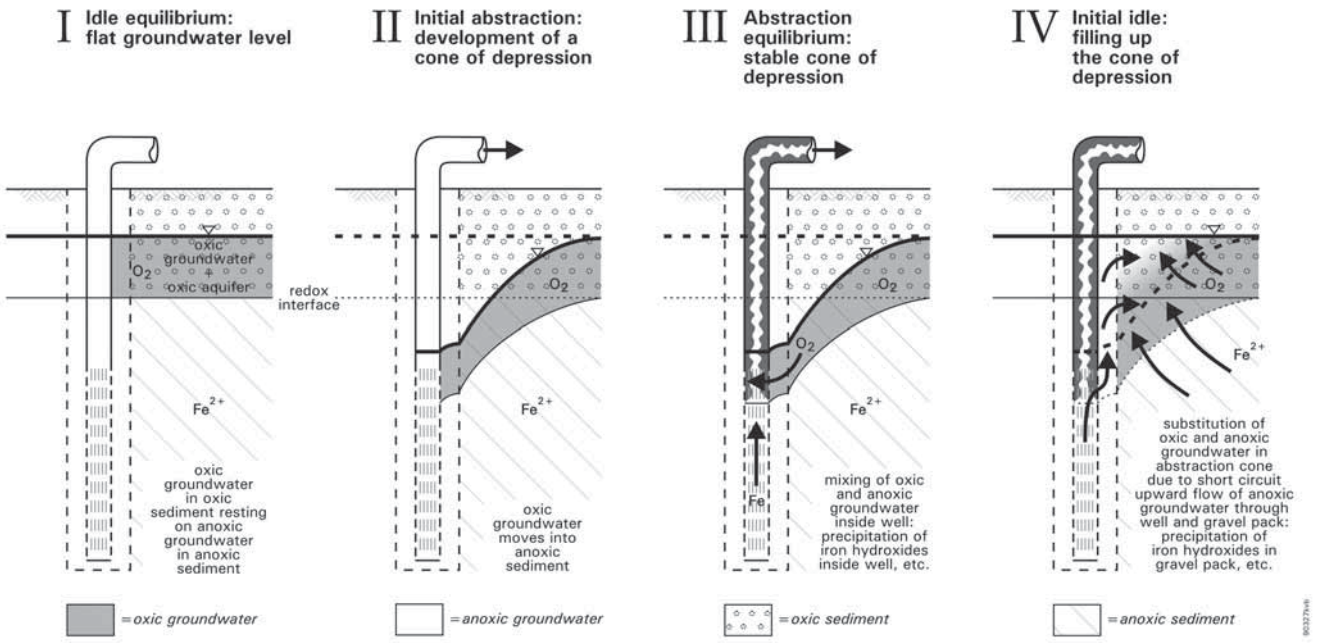
Clogging definition

After commissioning a new well the specific capacity is determined. This is expressed as the capacity of the well (in m^3/h) over the drawdown (m). The drawdown equals the water level in the well during drawdown minus the water level during rest. The specific capacity at commissioning serves as a reference standard during the ensuing operation.

Clogging is defined as a decrease in specific capacity over time. There are two types of clogging: screen slot (or chemical) clogging and well bore (or mechanical) clogging, which can be easily distinguished with the help of entrance resistance, defined as the difference between the water level in a production well and in a monitoring well, during abstraction. Figure 1 presents a schematic diagram of both types of well clogging and explains the absence and the growing presence of the entrance resistance in relation to the location of the accumulated clogging material.

The characteristics of (and the differences between) both types of clogging are summarized in Table 1.

These characteristics should mutually corroborate each other. The occurrence of screen slot clogging is accompanied by dirty field lines and the presence of oxygen in the abstracted groundwater (although its concentration in the abstracted groundwater may be very low), and so on. As it is very hard to measure accurately the presence of oxygen (often the measurement is false positive), measurement of the presence of nitrate will suffice. If nitrate is present at reasonable levels, oxygen is usually



present too. Table 1 also shows that even during drilling it is possible to recognize whether there may be the risk of screen slot clogging.

Screen slot clogging

Clogging of the screen slots by accumulation of iron hydroxide precipitates is caused by the simultaneous abstraction of two incompatible water qualities, i.e. shallow water containing oxygen and deeper water containing iron. The two waters mix in and around the slots at the lower end where oxygen enters the well. However, precipitation of iron hydroxides is a slow process, so the majority precipitates in the upper part of the well and in the field lines. The abstracted groundwater also contains iron oxide and bacteria. If conditions become favourable, bacteria may multiply profusely and form slimes (biofilms), causing further clogging (see Figure 2).

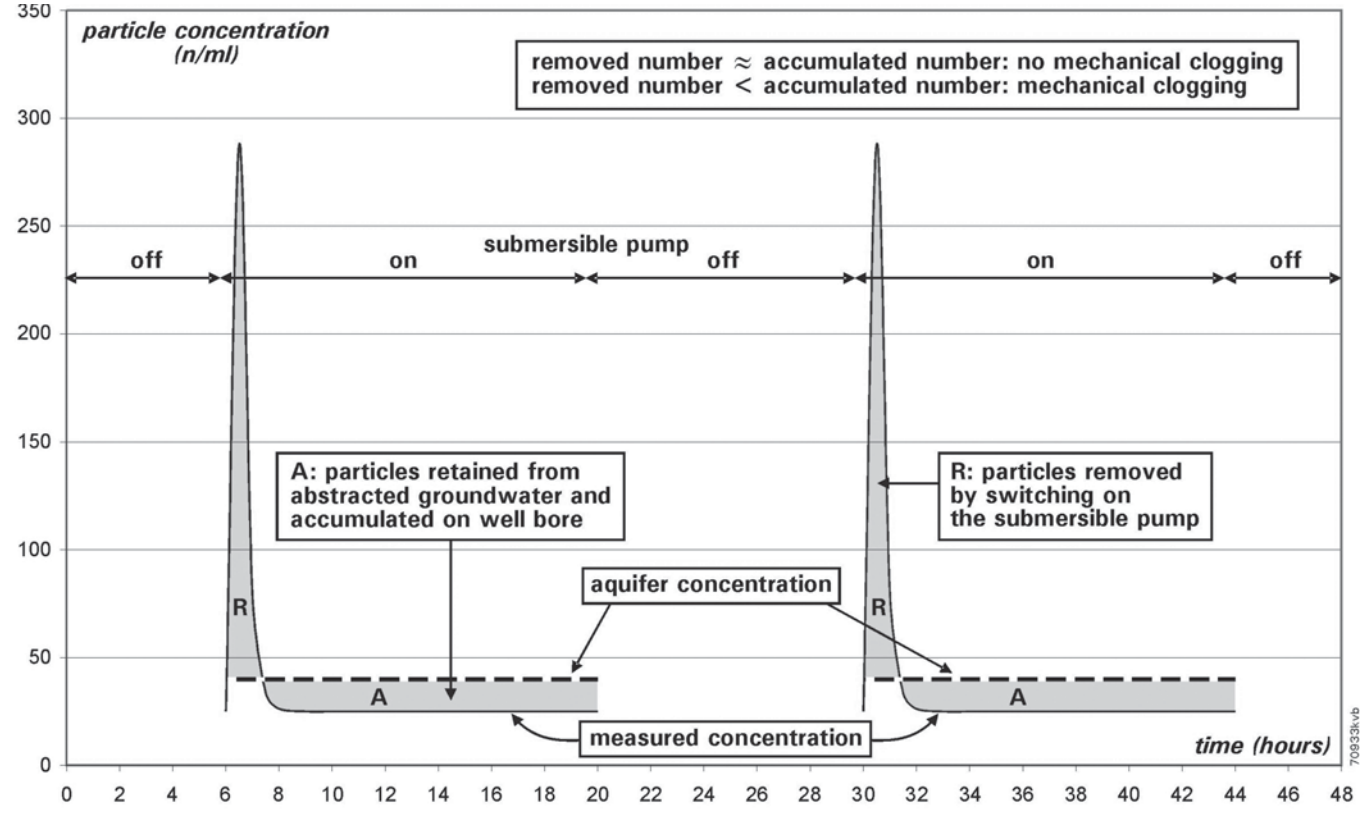
When the abstraction pump is not in use there is ample time for the development of slimes and iron hydroxide precipitates. Conditions for mixing are ideal if there is some flow in the well, such as filling up of the abstraction cone with groundwater around the well, or short circuit flows in the well itself and between the well and neighbouring wells.

Figure 2: Four phases in groundwater abstraction demonstrating cause and prevention of screen slot clogging.

Figure 3: Cause and prevention of well bore clogging: A) particles retained on the well bore during abstraction; R) particles removed by switching the well on.

The cause of screen slot clogging leads us to the method of prevention: continuous abstraction. Because the precipitation of iron hydroxides is a slow process, precipitates will develop after some time, beyond the screen slots. Therefore, if water is continually abstracted, precipitates will not develop in the screen slots but further down the well pipe and in the field lines. This means that it is not necessary to clean the screen slots, but obviously the well pipe and field lines should be cleaned regularly.

Moreover, all kinds of technical precautions have been devised to delay



Coming soon from IWA Publishing

Cause and Prevention of Clogging of Wells Abstracting Groundwater from Unconsolidated Aquifers

Author: C.G.E.M. (Kees) van Beek

IWA Publishing, October 2012. 192pp. Paperback.
ISBN: 9781780400242. Price: £79.00 / US$142.20 / €106.65 (IWA members: £59.25 / US$106.65 / €79.99).
www.iwapublishing.com

the mixing in the well screen, but if prevention is not possible, the well head can be constructed in such a way that clogged wells may be rehabilitated conveniently in a short time. It is also possible to prevent screen slot clogging by applying sub-soil iron removal: removal of iron from groundwater in the aquifer.

Well bore clogging

Well bore clogging is caused by the accumulation of soil particles on the well bore, where the upper diameter of the particles varies between 25 and 50μm. These particles, consisting of normal soil material like clay, quartz, calcite and organic matter, are carried along with the water flowing towards the well, where larger particles cannot pass the pore necks in the well bore. The pore necks in the well bore may be smaller than in the aquifer due to incomplete restoration of the original conditions after drilling, through for instance the presence of drilling mud and fine sands blocking the well bore pores.

All groundwaters most probably contain particles, but concentrations in aerobic groundwater are usually much lower than in anaerobic groundwater. The highest concentrations are encountered where there are changing groundwater quality conditions, for instance bank filtrate and groundwater pollution.

By starting the pump, groundwater surrounding the well begins movement, which gradually changes into a steady flow. This acceleration exerts great forces on the surroundings of the well, mobilizing accumulated particles. As long as the starting pump is able to mobilize all particles that have been accumulated on the well bore during the preceding abstraction interval, no clogging will occur. This reasoning is presented in Figure 3. Consequently, this type of clogging may be prevented by intermittent abstraction.

Besides intermittent abstraction there are other ways to mitigate well bore clogging: reducing the supply of particles by installing a smaller pump or applying a larger diameter bore, or facilitating the passage of particles over the well bore by maximal development (maximal removal of drilling mud and invaded fine sand).

Conclusions

Wells abstracting groundwater are susceptible to clogging, resulting in a decrease of the specific capacity over time. There are two types of well clogging, which can be easily diagnosed. Screen slot (or chemical) clogging is usually caused by an accumulation of iron hydroxide precipitates in the screen slots, whilst well bore clogging is caused by an accumulation of soil particles on the well bore. Both types of clogging can easily be prevented, or at least mitigated, by two opposing methods of well operation: continuous abstraction for wells susceptible to screen slot clogging and intermittent abstraction for wells susceptible to well bore clogging. ●

About the author
Dr C.G.E.M. (Kees) van Beek is a specialist in well clogging and in groundwater chemistry at KWR Watercycle Research Institute, Nieuwegein, the Netherlands. Email: Kees.van.Beek@kwrwater.nl.

READING AND RESOURCES

New publication

Dynamic Cost Comparison Calculations Appraisal Manual for Project Designers

● An international working group has prepared a User's Project Appraisal Manual for selecting least-cost solutions in water supply and wastewater disposal. To meet the goal of economic efficiency, which is focused on an optimised use of the available resources, there is a strong need for comprehensive guidance on how to support the planning process by an adequate tool. In accordance with the development and successful implementation of such standards in Germany, dynamic cost comparison has been chosen as the most suitable appraisal method.

To identify and localise the individual needs for action and to create a made-to-measure guideline, the working group has not only focused on the specific requirements relating to the design of suitable help tools for determining economic efficiency, but also on their practicability and performance, says the publisher, DWA. ●

**DWA, December 2011.
ISBN: 9783941897052
133pp. Price: €58.00, DWA Corporate Members price: €46.40.
To order, visit: www.dwa.de/shop**

New publication

Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century

● This new guide from the World Bank provides forward-looking operational assistance to policy makers and technical specialists in the rapidly expanding cities and towns of the developing world on how best to manage the risk of floods. It takes a strategic approach, in which appropriate risk management measures are assessed, selected and integrated in a process that both informs and involves the full range of stakeholders.●

**World Bank, February 2012.
ISBN: 9780821388662
632pp. Paperback and PDF.
Price: $40.00 for print copy.
To download or order, visit:
http://publications.worldbank.org**

Online resource

Discharge Monitoring Report Pollutant Loading Tool launched

The US Environmental Protection Agency (EPA) has announced the release of a new tool that provides the public with important information about pollutants that are released into local waterways. Searches using the DMR Pollutant Loading Tool result in 'top ten' lists to help users easily identify facilities and industries that are discharging the most pollution, as well as impacted water bodies.
See http://cfpub.epa.gov/dmr/

Water treatment

Pentair 'hybrid DI' water conditioning debuts in US

● Pentair Residential Filtration, LLC, a subsidiary of Pentair, Inc., a global provider of water treatment solutions, has launched its new electronic water purification system to the North American water industry. It is built around a hybrid deionization (hybrid DI) process, using Pentair and Voltea technologies to combine the benefits of reverse osmosis filtration with those of a water softener – without requiring salt as a regenerant.

Pentair developed the new technology through a partnership with the Dutch firm Voltea, which has licensed the technology exclusively to Pentair in residential and light commercial applications for point-of-entry products. The new technology uses capacitive electrodes to remove hardness and total dissolved solids from water without employing salt. The core of the system is Voltea's patented 'stack' configuration of electrodes combined with ion-selective membranes.

The treatment sequence begins with the purification step. This occurs as untreated water flows through the cell, where ions are drawn through the membranes and absorbed in the charged electrodes, producing treated water. The electrodes automatic-ally regenerate when the system reverses its polarity. This drives the ions out of the electrodes and flushes them from the stack. The polarity is then reset to normal to start purification again.

Pentair will use the new system in products for light commercial applications such as retail operations, car washes and laboratories. The technology will also be used in products for residential customers through an agreement with Aquion, Inc.'s RainSoft brand.

● **www.pentair.com**

Point of use

OASIS water coolers team up with Philips for instant disinfection

● OASIS International has announced its new partnership with Philips Lighting. OASIS and Philips have partnered to integrate Philips' InstantTrust UV disinfection system into OASIS' water coolers.

OASIS says that there is demand for point use disinfection from consumers concerned about the quality of drinking water, in both developing and developed countries. OASIS says that consumers are increasingly relying on their own residential filters, regardless of whether there is a public infrastructure in place to decontaminate water. Philips InstantTrust disinfects water as its being dispensed, up to 4 litres/minute, and what it says is its unique design works indepen-dently of water temperature, disinfecting both hot and cold water on demand. The new Philips InstantTrust solution is designed to fit point-of-use water delivery solutions including taps, water pitchers, under-sink water filters and portable systems.

'One of the most important trends in the world is the need for clean water,' says Ernest Sanderse, Marketing Director of Philips Lighting. 'You can see that purifiers installed in the home are increasing day by day, and [with UV] there is no need for chemicals. This is cutting edge because it is solving current limitations of UV. With InstantTrust we can treat hot and cold water instantly.'

First to market with InstantTrust water disinfection

inside will be the OASIS KALIX Point-of-Use water cooler, Aqua Pointe and VersaFiller Bottle Fillers. **CF**

● **www.oasiscoolers.com**
● **www.lighting.philips.com**

Water treatment

New compact water purifier can treat water for 10,000 people a day

● EDGE Outreach, a non-profit organisation that trains and equips communities to ensure safe water and sanitation provision, has announced the release of its M-100 Chlorine Generator Kit, which uses sodium chloride and a 12-volt car battery to produce chlorine gas for injection into water to be treated. The M-100 Chlorine Generator can treat up to 38,000 litres of water a day.

'One of the greatest challenges in the world of water develop-ment is for nationals to have access to the knowledge and products to take care of their own water supply,' said Mark Hogg, Executive Director of EDGE Outreach, when speaking to *Water21*. 'Bacteria is one of the greatest issues. This unit very simple to use and can be easily used along with filtration. Delivery and storage can be concerns in preserving purity. Using the M-100 in a batch process and making large amounts of pure water leaves the problem for people to transport water, [however], chlorine generated from the unit as a byproduct can be used to clean containers. Also, as we have proved in disaster situations, the chorine and sodium hydroxide can be used to sterilize medical instruments and neutralize latrines.'

The M-100 is already in operation in various countries. This past year, it was used aboard the USNS Comfort Continuing Promise Mission and most recently in the flood-affected areas of Pakistan. **CF**

● **www.edgeoutreach.com**

Monitoring

New fully-featured portable water quality monitoring system from Palintest

● Palintest Ltd, a provider of water analysis technology, has launched the new Macro 900 Water Quality System for multipa-rameter water quality monitoring. The Macro 900 WQS has been designed for environmental surveys, aquaculture applications and wastewater and surface water monitoring, says the company.

The Macro 900 Meter forms the core of the system. It is completely waterproof, battery-powered and includes three dimensional GPS positioning as standard, storing up to 1900 full data sets of results. The high-contrast LCD screen is backlit for use in low light environments and the rubberised function keys are designed for effective use even with wet or gloved hands.

Macro Accessory Probes allow the system to monitor a wide variety of parameters, including: pH, conductivity, total dissolved solids, turbidity, depth and both optical and galvanic dissolved oxygen (automatically compen-sated for atmospheric pressure and salinity). All Macro Accessory Probes are simple to maintain, manufactured in marine grade aluminium and only 48mm in diameter to ease use in narrow boreholes, says Palintest.

● **www.palintest.com**

Water transfer

MZT Pumpi Macedonia installs new pumps for power plants

● MZT Pumpi Macedonia, a manufacturer of industrial pumps in south-east Europe, has successfully produced and delivered 39 centrifugal pumps for the transport of clean and slightly polluted water to Elektroprivreda, a power utility in Bosnia and Herzegovina.

For the purposes of the company's Thermal Power Plant Kakanj, located on the bank of the river Bosna, MZT Pumpi installed four types of centrifugal pumps (end suction and multistage), for the transport of clean and polluted water.

For the larger Thermal Power Plant Kreka in Tuzla, which has significant geological reserves of lignite and brown coal, MZT Pumpi installed six types of End Suction Centrifugal Pumps and Multistage Pumps for transport of pit aggressive wastewater.

MZT Pumpi also installed centrifugal pumps into the coals mines Breza, Dzurdzevik and Abid Lolic Bila-Travnik, and Zenica for the transport of polluted water.

● **www.pumpi.com.mk**

Water supply networks

SebaKMT releases multi-correlator for accurate leak detection

● SebaKMT, a manufacturer of water loss reduction systems, has just released its Sebalog Corr, a multi-correlator for leak detection. Multi-correlators, also known as 'correlating loggers', are a hybrid form of a field correlator and a set of noise loggers, which combines the independent operation mode and the high number of the loggers' sensors with the correlators' ability to calculate the exact distance to the leak using the sound it makes.

SebaKMT's Sebalog Corr has a pinpointing mode, wireless communication with the loggers' sensors, and a GPS-based leak navigator. After the position of the leak is determined by means of automatic correlation, it must be marked on site for repair. Once the GPS position of the sensors is recorded and the GPS receiver is connected to a computer, the leak navigator leads the user directly to the leak. The position of the user is continuously displayed on the map so that they know when they have reached the location of the correlated leak.

● **www.sebakmtaus.com**

Monitoring

GF Piping Systems introduces Signet 9900 SmartPro Transmitter

● GF Piping Systems has added the new Signet 9900 SmartPro Transmitter to its line of flow and analytical measurement instrumentation. The new device features multi-parameter capabilities, flexible modularity and an auto-sensing backlit display with at-a-glance visibility, even in dark conditions, says the company.

The Signet 9900 Transmitter provides a single channel interface for many different parameters including flow, pH / ORP, conductivity / resistivity, pressure, temperature, level, salinity and other sensor types that output a 4 to 20 mA signal. The single channel, multi-parameter capability and field upgradable modularity allow customers to increase their service level all while maintaining reduced inventory levels, says GF Piping Systems.

● **www.piping.georgfischer.com**

Pentair X-Flow ultrafiltration selected for UAE desalination plant

Pentair X-Flow has been selected to supply its Seaflex ultrafiltration (UF) membranes to the Al Zawrah seawater reverse osmosis (SWRO) plant in Ajman, United Arab Emirates. The UF system in the new Al Zawrah desalination plant will produce 4783m³/h (115 MLD) pretreated seawater to feed the reverse osmosis membrane system.
www.xflow.com

Jacobs receives contract from Metropolitan St. Louis Sewer District

Jacobs Engineering Group Inc. has announced that it has received an award from the Metropolitan St. Louis Sewer District to provide professional engineering services for the Lower & Middle River des Peres CSO (combined sewer overflows) Controls System Improvements in St. Louis, Missouri, US. The estimated total construction value is $1 billion. The project is expected to be complete in approximately 2030.
www.jacobs.com

Lone worker communication devise selected by American Water

Connexion2 is supplying its lone worker device, Identicom, to American Water. The Identicom lone worker device looks like a normal identity badge but has a GSM communications device with GPS and Man-Down functionality. If a user feels their safety could potentially be compromised, it opens a voice channel back to the G4S monitoring centre. The device can also record voice messages left periodically by a user in line with information reflecting their activity.
www.connexion2.com

Thames Water and SmartReach extend smart water meter trial

SmartReach, a collaboration of Arqiva, BT, BAE Systems Detica and Sensus for smart metering communications in Great Britain, has announced the extension of its smart meter and smart grid trial to include London. This extension to the trial will enable Thames Water and SmartReach to assess the performance of the communications system from locations with different housing stock and difficult to reach, underground meter locations.
http://smartreach.com

SPS launches 'drought busting' treatment solution

Water treatment specialist Siltbuster Process Solutions Limited (SPS) has launched its new 'drought busting' solution, the D100ds DAF (dissolved air flotation) system. 'Traditionally, emergency abstraction has been hampered by the need to deploy additional equipment to cope with the high suspended solids and algal concentrations found in sources during the summer months,' comments SPS's managing director Dr Richard Coulton. 'That is where the SPS D100ds system comes in.' Depending on the characteristics of the water, the system can process between two and four megalitres of water per day.
www.siltbuster.com

Biotec now selling Aerocover to the water industry

Biotec Ltd, a UK-based research and development company, has announced that its Aerocover floating cover is now available for the wastewater treatment industry. Aerocover is buoyant lightweight covering of aggregate floated on the surface of tanks and lagoons to prevent the release of ammonia, hydrogen sulphide, carbon dioxide and other volatile organic carbons, and therefore reduce odour problems.
www.biotecltd.co.uk

ISSN (print): 1747-7751
ISSN (online): 1747-776X

URBAN WATER MANAGEMENT

Developing tools for tomorrow's urban water services: *project TRUST investigates leading-edge solutions*

● Europe's TRUST project is aiming to develop a range of approaches and tools that can be applied to urban environments to facilitate the transition to more sustainable service delivery. **LIS STEDMAN** spoke with a number of TRUST work area leaders on the range of research activities taking place.

An ambitious European Commission (EC)-funded Seventh Framework Programme project, TRansitions to the Urban Water Services of Tomorrow (TRUST), has been underway for around ten months. The four-year project is driven by the need for transformation and a desire to protect natural resources, and involves 30 partners in 11 different countries who are undertaking a comprehensive programme of researching innovations and tools that, it is hoped, will be able to create a more sustainable, low-carbon water future.

There are eight work areas (WAs) within the project, led by names that many members of IWA in particular will recognise: WA1 is diagnosis and vision, led by Professor Rui Cunha Marques; WA2 is policy, financing and society, led by Professor Paul Jeffrey; WA3 is analysis tools, led by Professor Sveinung Saegrov; WA4 is technologies and operational options, led by Professor Thomas Wintgens; WA5 is future water policies and integrated tools, led by Dr Helena Alegre; WA6 is implementation and demonstration, led by Dr Theo Van den Hoven; WA7 is dissemination and knowledge transfer, led by Professor Enrique Cabrera Jr; and WA8 is management, led by Dr David Schwesig.

The results will be implemented and tested in nine participating cities or regions, which are grouped as one of three types – green cities, water scarce regions, and urban / peri-urban areas.

Tools for sustainable development

Germany's IWW Water Centre co-ordinates the project. From there, Dr Schwesig, a Research Co-ordinator at IWW, has a managerial and overview role in WA8. He notes that in TRUST there will be a 'whole range of different products from analysis tools to guidelines and actual technologies. We want to enable cities to assess their current performance, including web-based self-assessment tools. We also have in mind to address the barriers, which can be governmental, social, funding or financial. We are developing tools to assess the adaptive potential and governance conditions, and aim to deliver validated technology and management options to support the transition to more sustainable urban water services.'

Dr Schwesig notes that the TRUST project was developed within the WssTP (Water Supply and Sanitation Technology Platform), where the idea took shape and from where a number of the project members originate. TRUST also builds on other European projects, notably TECHNEAU, SWITCH and PREPARED (which aims to prepare cities for climate change).

He talks about one of the critical phases, which will be when the research and discussion have taken form and are applied in the TRUST cities. He explains: 'We selected cities that we have good working relationships with, that fit into the three categories and gave a certain geographical coverage, and importantly, cities that were ambitious to change and face their challenges in an active way. These are also cities that have close links with a regional research partner. Each city is assigned to one specific research partner acting as the main interface, because implementing the first stage may require significant support and training.'

Sustainability in the water cycle

One crucial early part of the project is WA1, led by Professor Marques. He explains that the first task was a review of all the ways of measuring (and defining) sustainability, across not only water utilities but the whole water cycle. This has included a global literature review, and a move to identify the state-of-the-art and the principal aspects of sustainability – a set of 50 questions was identified and sent to the participating utilities as part of this process.

Professor Marques explains that as well as the traditional social, environmental and economic criteria, sustainability of urban water systems has further dimensions – governance and infrastructure – that are critical to include. A set of objectives, criteria, indicators and other metrics for each dimension was developed (for example, in the social criterion, meeting the needs and expectations of customers) and several examples of sustainability scorecards were discussed and analysed.

Strategic infrastructure management

Dr Helena Alegre, senior researcher at LNEC, the National Civil Engineering Laboratory of Portugal, explains that WA5 'has to do with the tools and methods that will support infrastructure asset management in an integrated perspective.' This work area's role is to produce approaches and materials that can directly be used by utilities in the decision-making process. It builds up from the expertise and findings of the other work areas on governance, economic and technological issues and from those developed by LNEC and its partners in-house (such as www.aware-p.org).

'Based on the knowledge developed during the project we need to produce recommendations, guidelines, technical books, e-learning materials and leading-edge software. The objective is to assist utilities and decision makers in general, in terms of how to manage their infrastructures strategically, coping with the transition between the urban system of today into the system of tomorrow,' Dr Alegre notes.

Dr Alegre is also senior vice-president of IWA, and as IWA is a partner in TRUST, she is also extremely happy that the 'vast majority' of the outputs from WA5 will be in the public domain, noting: 'I believe this way they will have a much bigger impact. This is a win-win opportunity for IWA that may provide members with valuable information and leading-edge professional solutions'.

Dr Alegre acknowledges the similarities between TRUST and the IWA's Cities of the Future Specialist Group, but adds: 'Cities of the Future is very much looking to the leading-edge, non-classical solutions, being essentially directed to new developments. These solutions are often disruptive and are not easily applicable to existing urbanised areas. In our case, the main focus is on how to manage the transition from the current situations to the sustainable services of the future. We have to say, it would be nice to get there, but we cannot ignore that we are here, so can we get there, and if so how?' ●

This is a shortened version of an article that appeared in the March 2012 edition of Water Utility Management International. See www.iwaponline.com/wumi.

Dr David Schwesig

Do large-scale meetings help progress towards better water management?

With the 6th World Water Forum having taken place last month and the Rio+20 Conference in June, 2012 is a busy year for major discussions on water and sustainability. However, do these events actually advance progress on water management issues? **JAMIE PITTOCK** spoke to four water experts to find out their views.

2012 is a year of big international water-related meetings and many readers will be asking whether they are just talkfests or do they really result in change and progress for the water sector? Two events are prominent in a busy year. In March the water sector gathered in Marseille for the triennial World Water Forum, then on 20-22 June the world's governments will meet in Rio de Janeiro at the UN Conference on Sustainable Development.

The World Water Forum

Tagged 'time for solutions', the Forum has set an aim to develop and trigger actual implementation of concrete solutions through the achievement of a series of targets in a number of priority areas. The thematic targets focus on 12 priority areas and three cross-cutting conditions for success. Are such efforts to develop targets worthwhile? In the case of sanitation the answer is clearly 'yes'. In 2000 our national governments adopted a Millennium Development Goal target to halve the number of people without adequate access to water by 2015, which was ludicrous without the necessary counterpart target for access to sanitation. A basic sanitation target was adopted in 2002 after consensus-building at events like the Forum. Hence, work at the Forum that was not legally binding led to a globally accepted target and increased attention to delivering a vital water service. As a consequence, the adoption of targets – like that for sanitation – has provided a mandate and focus for investment by national governments and inter-governmental organisations to address key water-related issues. So, will the Forum now encourage this once-a-decade UN Conference in Rio to adopt goals for more ambiguous outcomes like better water governance?

Dr Katherine Daniell, a Research Fellow at The Australian National University declares: 'By ensuring that decision-making processes linked to water management are effectively organised and developed in ways that are transparent and openly inclusive of stakeholders at all relevant levels, there is a greater chance that acceptable, implementable and mutually beneficial decisions can be made. Unlike previous fora that have focused on key issues and principles for water management, which have not escaped criticism of just being "talkfests", this Forum [was] focused on highlighting and sharing already implemented or potential good practice examples or "solutions" for better water management. Giving attendees a real opportunity to learn from each other and to take ideas about better water management and governance practices back to their home countries and workplaces, should hopefully lead to real concrete outcomes in the years to come.'

Ms Karin Lexen, Director of the Swedish Water House at the Stockholm International Water Institute, comments: 'You need meeting places: that is what the Forum is, a huge meeting place. This Forum focus[ed] on solutions and targets and is a step forward. Of course there are limitations with such a big event, but it is not all about the intergovernmental processes; it is also about different parts of the water community meeting and learning from their different perspectives and experiences.'

Targets and indicators

Setting targets and good indicators for better water management is widely regarded as vital. 'Targets and indicators are really very important; without them it is very difficult to evaluate where you stand,' says Ms Lexen. 'They make the required action more concrete. That is why the international water community adopted strong proposals for action by 2030 in the Stockholm Statement. The targets adopted at Rio have to be realistic and balance idealism versus the resources to implement and monitor them.' In considering how the previous global Millennium Development Goals (2000) and Johannesburg agreements (2002) for improved water supply, sanitation and water planning have been used to date, Ms Lexen observes that: 'Sometimes the lack of resources for measuring and comparing different countries, and a limited willingness to be transparent, has detracted from their full use. However they have served their purpose of making some issues more concrete, speeding up implementation and in raising awareness. Like many in the water community I'd like to see quicker action, but I urge us to see the glass has half full rather than half empty.'

'Targets and indicators are used to measure if the management objectives are going to be met or missed,' adds Dr Lifeng Li, Director of the Freshwater Programme for WWF. 'Without them, it won't be possible to say whether we are doing better or worse water management.'

Dr John Matthews Director, Freshwater Climate Change at Conservation International, concurs: 'I think that targets and indicators are absolutely critical for sustainable water management, especially as we begin to more formally incorporate resilience thinking into sustainable water management plans, such as developing adaptive, flexible management plans for responding to tipping points and thresholds for major change, and creating more process-based approaches to infrastructure design and management.'

Compared to previous fora, this World Water Forum appears to this critic to have had a broader range of the water community engaged in developing targets for solutions on a wider range of priority issues. Yet will the Forum process help, for example, improve conservation of freshwater ecosystems? 'Very little, unfortunately, at least in the formal programme', says Dr Matthews. 'The Forum tends to operate at a fairly high, vague, and institutional display level of policy rather than either the more muddy-

boots-on-the-ground project scale where most actual work and decisions are implemented or even at the level at which senior decision makers consider and develop new strategy.'

By contrast, Dr Li says: 'So far the environmental aspect hasn't been mainstreamed into water management and the Forum has showed its leadership and pathways towards integrated water management for achieving social, economic, and environmental objectives.'

How then will this action in the water community at the Forum translate in Rio?

The UN Conference on Sustainable Development

Unlike the lead-up to the United Nation's Rio conference in 1992 and Johannesburg conference in 2002, the agenda in 2012 appears narrow. For instance, a UN Commission on Sustainable Development water issues brief published in December lists among previous commitments only those around water access, sanitation and planning. Inexplicably omitted are previous water-related agreements in areas like biodiversity conservation and river basin management. There are many well-developed ideas on the next steps in global water governance. For instance, last August the Stockholm World Water Week adopted a statement to the 2012 Rio conference proposing practical targets for 2030 related to water quantity, efficiency and reuse, pollution reduction, use in agriculture and energy production, the role of water in a green economy and the institution reforms required.

In January the United Nations pulished 'The Future We Want' for negotiation, the so-called 'zero draft' of the intergovernmental agreement anticipated from the Rio conference. The text reiterates but appears to go no further than previous promises in the Millennium Development Goals and from Johannesburg in 2002 to improve water supply and sanitation services, including through integrated water resources management and water efficiency plans. The three paragraphs on 'water' compare to nine for 'oceans, seas and small island developing states'. While 'forests' include biodiversity, nowhere is there recognition of the parlous state of freshwater ecosystems. There are a number of surprising omissions. The ambitious biodiversity conservation targets for conservation of inland waters and coastal biodiversity agreed under the UN Convention on Biological Diversity in 2010 are missing. There is no mention of collaborative management of transboundary waters despite the likelihood that the (1997) UN Watercourses Convention will soon enter into force and the UN's designation of 2013 as the International Year of Water Cooperation.

Should the water community be alarmed that the centrality of good water governance for the environment and sustainable livelihoods is so poorly appreciated by our government negotiators? 'Yes,' says Dr Daniell, 'it is concerning that little of the work of the Forum seems to be reflected in the Rio+20 zero draft, in particular, the importance of good water management and governance in underpinning poverty eradication, human health and ecosystem services. Although such aspects are mentioned late in the document in the "water" section, not including the importance of access to and management of water (in sections like 11) on factors adversely impacting development gains, it seems like a real oversight and could damage future attempts at ensuring sustainable development.' Dr Matthews elaborates: 'My concerns with the utility of the Forum extend as well to Rio+20, and the new language around green economies seems more likely to obscure other well-defined issues around climate change mitigation, sustainability, and resilience to climate impacts than to inform and resolve them. I am particularly concerned at the lack of coherence between climate change mitigation (especially energy generation and the water embedded in hydropower, coal, nuclear, and solar energy sources), climate change adaptation (especially water access, ecosystems, agriculture, cities), and the differences between developed and developing country in resolving these competing claims for economic development strategy and investments.'

'There is considerable room for improvement of the Rio agreement. If we really want to influence that process then the water community needs to be very active in suggesting amendments and try to influence participating governments back home in their capitals.
Karin Lexen, Director of the Swedish Water House

Ms Lexen also agrees that it does not reflect the Forum's work. 'There is considerable room for improvement of the Rio agreement. If we really want to influence that process then the water community needs to be very active in suggesting amendments and try to influence participating governments back home in their capitals. It is not only the water section of the Rio agreement that we need to influence to mainstream better water governance. The Marseille meeting provided a good opportunity for the water community to gather for a joint push, but in order to influence the outcome we need to be active throughout the whole process. There is not too much on water supply and sanitation: we need even more on this. We should also be looking at influencing the sections and proposed targets on energy, food, the green economy and jobs. It is disappointing that there is nothing so far on transboundary waters.'

Environmental representatives express substantial concern. Dr Matthews comments: 'The last ten years or so of experimentation has clearly shown us that any discussion about infrastructure, expansion of the water franchise, water management generally, and water consuming and managing institutions must place a process-based awareness of climate, climate change, ecological change, and institutional learning at the centre of water resources management. Unfortunately, I do not see this basic, hard-won realization reflected in the Rio+20 documents.'

Dr Li concludes: 'It's disappointing that the value of living freshwater ecosystems – rivers, lakes and wetlands, haven't been recognized. It seems that only after river gets dry, people will realize that pipes and taps won't ensure water security to them.'

Why then is the broad range of benefits from better water management so poorly reflected in the Rio draft? As Ms Lexen concludes: 'I think that there are two reasons. First, water has been poorly represented in major international processes such as the conventions on climate change and on biodiversity. Second, strong lobby groups have sought to influence the draft agreement for the last year and a half. It may be that we've not been that active as a water community. We have to look at ourselves a bit. We should have been more active from the beginning.' ●

More information
Stockholm Statement to Rio+20: www.worldwaterweek.org/documents/WWW_PDF/2011/2011-Stockholm-Statement.pdf

6th World Water Forum priorities: www.worldwaterforum6.org/en/commissions/thematic/priorities-for-action-and-conditions-for-success/

Rio+20 UN Conference in Sustainable Development:
- **Goals and indicators and water issues briefs: www.uncsd2012.org/rio20/rio20issuesbriefs.html**
- **Zero draft agreement: www.uncsd2012.org/rio20/futurewewant.html**

Outlining the vision for US source water protection


Jennifer Warner

The Water Research Foundation released a two-part report earlier this year, displaying results and providing recommendations on source water protection in the country. **BILL McCANN** spoke with **JENNIFER WARNER** about the research that was undertaken for this.

A new document, published in January, will provide the basis for a much-needed structured approach to source water protection in the United States.

Publication follows five years of research, funded by the Water Research Foundation (WaterRF) and initiated in response to numerous questions and requests from WaterRF subscribers. Coming in the form of a two-part report the publication provides a vision of the ultimate goal – that, by 2025, every public community water supply will be protected by an active source water protection programme – and a roadmap of how to get there.

WaterRF Research Manager, Jennifer Warner, says feedback from water utility subscribers had, for several years, suggested the need for research in this area. In 2006 the Foundation's Research Advisory Committee decided the way forward would be to convene a workshop to discuss all the issues, categorize them and develop a research plan for strategic movement towards promoting source water protection.

That workshop duly took place in 2007, evolving a research agenda that divided source water protection into three topic areas, respectively addressing characterization and monitoring, tools and control strategies, and planning and programme management. The highest priority was allotted to this last area, leading to the January publication of the 'Source Water Protection Vision and Roadmap'. It is an output, says Warner, which should set the stage for future research and elevate the relative importance of source water protection within the overall water management strategy in the United States.

A need for source protection planning

A need was clearly present – preliminary interviews with 60 municipal utilities revealing that just 12 of the 30 using surface water sources had any kind of protection programme, not necessarily formalized or fully developed.

A similar situation applied with the 30 users of groundwater supplies, with many of these saying they needed help and expertise in developing an appropriate plan.

Warner says that this highlights the need for a strong mentoring programme in future, something that is emphasized in the Roadmap document. As she acknowledges, many of the difficulties for small suppliers stem from a lack of resources. In her words: 'This is a resource issue and an awareness issue. A lot of those small suppliers truly do not know where to begin. The Roadmap does a fine job in calling attention to the need for a mentorship programme, where sophisticated utilities like Philadelphia and New York City can help to mentor and provide some awareness and understanding from a practitioners point of view to these medium- and smaller-size utilities.'

Also extensively referenced in the document is the American Water Works Association's (AWWA) Standard for Source Water Protection (G300-07), and the accompanying guidance manual to assist in the development of individual source protection programmes. Warner describes that as an excellent starting point and notes that it took AWWA 'and its experts out in the field' a long time to establish. She says: 'It is a generalized framework that individual utilities can use to establish protection plans that account for their specific local conditions and stakeholder interests. Water utilities need to become more aware of that standard. I would hope that it comes to play a big part in future progress in this area.'

Raising awareness

Awareness-raising was one of the crucial themes to emerge during development of the Roadmap, the initial enquiries having established that some water suppliers believed they had no authority to establish a source protection programme, others that some other entity was responsible and a third group that saw no need for source protection.

Such findings highlight the need to move away from disparate approaches to source water protection across all levels of administration from local to national, and toward a co-ordinated approach within a catchment. The consensus of experts at a second workshop in Boulder, Colorado, in March 2010, was that this would best be achieved – and the Roadmap best championed – by appointing an individual leader to co-ordinate and motivate action.

Raising the profile of source protection is also important at this time, says Warner, in view of the interaction between source protection and subsequent drinking water treatment, and the current interest in establishing the costs and benefits of various catchment management practices. The challenge there, she says, is to demonstrate some clear, costed relationship between source water protection and costs at the treatment plant.

As she says: 'It is difficult to get a handle on the costs / benefits of source water protection, so it gets a hard time when it comes to funding decisions; much easier to make the business case for improvements at a treatment plant.'

Asked about the next steps, Warner says: 'We are progressing now with the other two areas for research originally identified, establishing partnerships with appropriate agencies and so on. But we hope the Visioning and Roadmap publication remains a living document and our job now is to get that into the hands of as many people as possible, including our subscribers first and foremost, and that is as far as we can take it.

'This was a tricky project for us, unusual because we rarely advocate a position, but this document does. It is trying to elevate source water protection as a key water management directive in the United States and that is a big challenge.'

For further information, see 'Source Water Protection Vision and Roadmap' and the background document 'Developing a Vision and Roadmap for Source Water Protection for US Drinking Water Utilities' which includes bibliography and case studies. Both documents are published by the Water Research Foundation and available to the public. ●

River impacts study based on Three Gorges reservoir

Researchers in China have used the Yangtze River and the Three Gorges reservoir to study downstream impacts of dams on river ecology, seeing such assessments as a basis for wider application to river restoration and water resources management.

In this study the researchers looked in particular at downstream conditions during periods of reservoir filling up to normal pond level for guaranteed power generation purposes. The study sites were at the reservoir and at the Yichang hydrological station 44km below the Three Gorges dam.

They looked at two reservoir filling periods, respectively from 21 September to 20 October and from 16 September to 15 October. In each case the filling period could be extended if the required level was not achieved by the defined end date.

Daily river flow data from the Yichang station, extending back over several decades before the reservoir was commissioned in 2003, allowed simulation of reservoir outflow processes for the two filling regimes.

A minimum instream ecological water requirement was established, closely associated with the flow-sensitive spawning period of Chinese sturgeon – October and November.

From the simulation results and historic flow data the mean periods of minimum instream ecological flow over the study period of September, October and November were calculated for five types of year, ranging from extremely wet to extremely dry. Frequency of minimum acceptable flow ranged from just 5% in the extremely wet year of 1964 to 95% in the extremely dry year of 1972.

On the basis of the computations a comparison of the two reservoir filling regimes showed that downstream river conditions varied between the two schemes and according to reservoir inflow conditions. The comparison indicated that, so long as flood security could be ensured in September, the earlier filling regime, commencing on 16 September, was the better choice for preserving downstream river ecosystem health and preserving adequate water flows in October, a particular safeguard to sturgeon spawning. ●

Impact of the Three Gorges reservoir operation on downstream ecological water requirements.
Qiongfang Li[2], Meixiu Yu[2], Jianhua Zhao[1], Tao Cai[2], Guobin Lu[2], Wei Xie[2] and Xue Bai[2].

[1]Nanjing Branch, Jiangsu Hydrology and Water Resources Survey Bureau, Nanjing, China
[2]State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University, Nanjing, China.
Email: li_qiongfang@hotmail.com.
Hydrology Research, 43.1-2, 2012. IWA Publishing 2012

Renewable power for treatment of rural supplies

Pointing to the plight of around a billion people in rural areas lacking access to both electricity and safe water supplies, researchers in the UK have made a laboratory-scale study of a wind-powered membrane treatment system.

A membrane system was directly connected to a 1kW rated, 48v (DC) output wind turbine mounted in a wind tunnel. The treatment facility consisted of a 1micron pore size polypropylene micro filter for pre-treatment, followed by a brackish water reverse osmosis membrane, with power applied through a 300W progressive cavity pump, giving pressure of up to 12bar across the membrane.

Previous work on a similar system had tested operation under wind speed fluctuations. This study concentrated on the effects on permeate quality and quantity of intermittent operation.

For testing under controlled conditions the turbine was replaced with a programmable power supply. Testing was over one-hour periods with six on/off cycles, with peak to peak amplitude varying between 60 and 300W (and minimum at 0W) and off periods varying between 0.5 and three minutes. Feed water was either 2750mg/l or 5500mg/l salt solution.

The study showed that on/off cycling immediately affected system hydraulics but resulted in a lag effect on permeate concentration due to the time taken for diffusion and flushing of the system. The system proved resilient to intermittent operation, producing a permeate of potable quality for all tested conditions except for a high concentration (5500mg/l) feed at low (60W) power. ●

The effect of intermittent operation on a wind-powered membrane system for brackish water desalination
G. L. Park[1], A. I. Schäfer[2] and B. S. Richards[1]
[1]School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, UK.
Email: glp2@hw.ac.uk
[2]School of Engineering, University of Edinburgh, UK.
Water Science & Technology, 65.5, 2012. IWA Publishing 2012.

Chlorination cuts oestrogen risks

In a laboratory study a United States research group has evaluated the ability of conventional drinking water treatment processes to remove oestrogens from surface water.

Since pre-treatment with chlorine is frequently a component of conventional treatment the study included also an assessment of oestrogenicity of the water before and after chlorination due to the presence of treatment by-products.

Taking conventional treatment to include a treatment train of rapid mixing, coagulation, flocculation, sedimentation, filtration and disinfection, jar tests were used to evaluate the ability of the coagulation process, alone and in combination with chlorine or powdered activated carbon (PAC), to remove three oestrogens from Ohio River water.

The oestrogens concerned were 17ß-oestradiol (E2), 17α-ethynylestradiol (EE2), and oestriol (E3) and the coagulants used were aluminium sulphate (alum) and ferric chloride.

The principal findings were that: coagulation alone, with alum or ferric chloride, achieved no significant oestrogen removal; PAC addition during the coagulation process removed all three oestrogens in a range from 23 to 77%; and, in all cases, oestrogen concentration decreased by 98 to 99% when the water was treated with a coagulant and chlorine, or with chlorine alone.

The efficacy of chlorine in removing the parent oestrogens came in association with formation of chlorine by-products but assessments of the water samples before and after chlorination showed that subsequent oestrogenic activity was also reduced, commensurate with reduction of the parent oestrogens.

It was concluded that chlorination in drinking water treatment could help manage the risks associated with steroid oestrogens in surface waters. ●

Removal of estrogens and estrogenicity through drinking water treatment
Kathleen Schenck[1], Laura Rosenblum[2], Thomas E. Wiese[3], Larry Wymer[1], Nicholas Dugan[1], Daniel Williams[1], Heath Mash[1], Betty Merriman[4] and Thomas Speth[1]
[1]US Environmental Protection Agency, Cincinnati, USA.
Email: schenck.kathleen@epa.gov
[2]Shaw Environmental and Infrastructure, Inc., Cincinnati, USA
[3]Xavier University of Louisiana, New Orleans, USA
[4]National Council On Ageing, Cincinnati, USA.
Journal of Water and Health, 10.1, 2012. IWA Publishing 2012.

THE PRESIDENT

Our message on the world of water and sanitation

I am sitting here on a Sunday afternoon in Marseilles, France, just before the opening of the World Water Forum, and wanted to share that the past two months have been very busy and productive ones for me. Among other visits in the US and to Singapore and Abu Dhabi, I have been to a water conference in Bangalore, India, and to the African Water Association (AfWA) Biennial Congress, this year in Marrakesh, Morocco. Each of these visits reinforces to me the need for transformation of the water profession from our historic focus on supply (for water) and disposal (for 'used water') to one of recycling and resource recovery.

The reasons for why we need to send this message are obvious. We live on a planet where we have exceeded its capacity to sustainably support human life in an acceptable fashion in the long-term, based on historic approaches to resource use. But, the solutions, at least for water and sanitation, are available and need to be implemented. We have multiple sources of water, including local capture, efficiency, and reclamation and reuse that can provide not only a sufficient but a resilient supply in the face of greater climate variability. The water stream, especially the used water stream, also contains resources (energy, nutrients, and materials) which can be harvested to service humankind, but also to provide financial support to our water and sanitation utilities. My visit to AfWA illustrated that some of our more forward-looking colleagues, even in developing countries, recognize these opportunities and are acting on them. But for the water and sanitation profession to capture these opportunities more consistently requires change on a broader basis. This message of much higher performing approaches needs to be sent both to others such as policy makers and supporters, but especially to our colleagues who do not understand the imperative for change.

We also need to better communicate the societal benefits of an effective water and sanitation system to policy makers and the public. Many ask: 'How can we afford water and sanitation?' Systems are in place in the developed world but in too many instances funding is insufficient to renew and replace aging infrastructure. Systems are lacking in much of the developing world and progress is lacking due to a lack of financial commitments. When one considers the benefits of an effective water and sanitation system, however, the question that should be asked is how can we NOT afford such systems! We know the health benefits of an effective water and sanitation system. Estimates vary, but the health benefit produced by an effective water and sanitation system is between seven and 15 times that of medicine to combat waterborne disease. Studies also demonstrate the economic benefits of such a system and that the economic benefits exceed their costs. This finding was reinforced by a recent study of the Indian economy that I became aware of at the Bangalore conference mentioned above. This study of urban infrastructure (not just water, but transportation, solid waste, and lighting) found that, if investments were increased from the current 0.7 percent of GDP to 1.1 percent of GPD, the need would be met over the next 20 years. Moreover, infrastructure constraints on economic growth (which elevates people out of poverty) would be relieved and the economy would grow by an additional 2 to 3 percentage points. In other words, the economic benefits exceed the costs.

We also look at the magnitude of the cost for an effective water and sanitation system. These are large numbers but, when expressed as a fraction of the total size of the economy (as was done in the Indian study), the ability to pay for these systems becomes obvious. Policy makers, and the general public, need to understand this. While the numbers are large, they are only a very small fraction of our total economy (which represents our ability to pay). The benefits in terms of health and the economy exceed the costs. When the further benefits of preserving the natural environment, which provides so many ecological services, are considered, the 'economics' of water and sanitation are obvious. But, who will tell this story if we water and sanitation professionals do not?

The messages of the need to change, coupled with the benefits of an effective water and sanitation system, are messages that the IWA is and will continue to send. Moreover, we are looking for methods to equip and enable our members and partners to tell this story more effectively and in a broader range of venues. Programmes such as Cities of the Future and Innovation are working in this direction, but we know that we need to do even more. The water and sanitation profession has a great story to tell. We just need to tell it more consistently and more effectively! ●

Glen T Daigger,
PhD, PE, BCEE, NAE
President,
International Water Association

Call for nomination of IWA Fellows 2012

It is time once more to nominate colleagues for the honour of becoming an IWA Fellow. The designation of Fellow is awarded to those members of the IWA who, in the judgment of their peers, have made a distinguished contribution to the advancement or application of water science and technology. An IWA Fellow is a member of an elite group of global water professionals with international recognition and renown for their guidance and leadership in the world of water science, technology and management as it continues to evolve.

An IWA Fellow can have made significant contributions as an application engineer or practitioner, an educator, a utility manager, a regulator, a research engineer scientist or as a technical leader.

This year we have introduced a new online nominations system. If you wish to submit a nomination for the IWA Fellows Programme, please visit http://iwahq.org/Nominations/Pages/ChooseNomination.aspx to begin the nomination process. The requirements for this award are also online.The deadline for receipt of nominations is 15 May 2012. ●

For further details contact Chloe Menhinick at: chloe.menhinick@iwahq.org

IWA Drinking Water Safety Awards – call for submissions

The IWA Drinking Water Safety Award scheme recognises excellence in the management of drinking water quality. The award scheme is aimed at service providers in low and middle income countries who have made demonstrable progress in improving and sustaining the quality of water provided to urban or peri-urban populations.

The award scheme seeks applications from service providers in low and middle income countries worldwide who are implementing water safety plans and have made demonstrable improvements in delivering safe water.

The deadline for submissions is 31 March 2012. The winners will be presented at the IWA / WHO Water Safety Conference in Kampala, Uganda (13-15 November 2012). ●

For further details, and submission requirements visit: www.wsportal.org/DWSAward, or email: wsportal@iwahq.org

IWA Honours and Awards 2012: call for nominations opening soon!

With a global membership consisting of over 10,000 water sector professionals IWA is in a unique and privileged position to have amongst its members the world's leading minds in water science and management.

IWA is committed to recognizing the special contributions and achievements of its members and water sector professionals through our Honours and Awards series, conferred biennially at the IWA World Water Congress & Exhibition – the next of which will be held this year in Busan, Korea 16-21 September 2012. There are various awards grouped under five categories that will open for nominations as of the First of April 2012.

IWA Global Water Award
This prestigious biennial award honours individuals whose work has contributed broadly to the development of urban water science, technology, management or policy. The criteria for selection includes the following key attributes: demonstrated excellence in science, technology, management or policy; vision, leadership, knowledge, persistence, creation of new directions and opening new fields; and recognition of the individual internationally within the IWA global water community. Awardees need not be an IWA member. ●

Details of all awards can be found at: www.iwahq.org/Home/About_IWA/Honours_and_awards

New training on water associations

The water sector has a need for organizations that provide utilities with a platform for networking and developing sector-owned solutions. Water and other technical associations are a common model for this self-organization.

Training will be held on 18-22 June 2012 in Hennef, Germany, in the offices of the European Water Association (EWA) and the German Association for Water, Wastewater and Waste (DWA) with participation of IWA, to facilitate the transfer of knowledge from these international, regional and national associations. Experience exchange and networking will be an important topic within and around the programme. ●

Contact: Laura Langel, DWA
T: +49 2242 872 240
E: langel@dwa.de. Web: www.dwa.de

Focus on IWA at the 6th World Water Forum

The 6th edition of the World Water Forum focused on providing solutions for the water and sanitation challenges around the world. An internet platform for posting solutions was created and around 1000 solutions are currently posted.

IWA's Statements at the Ministerial roundtables included the following: IWA Statement on the Practical Implementation of the Right to Water and Sanitation; IWA Statement on Turning Wastewater Stream Into Resource Opportunities; and IWA Statement on cities as catalysts for water, food and energy synergies. The full statements can be accessed on the IWA website.

IWA was also involved in a range of other activities.

Stakeholder engagement processes

IWA, its members, and several partners have, over the last few years, discussed the need for professionalising stakeholder engagement processes. Suez Environnement requested IWA to take part in the Forum sessions under the 'Condition of Success: Governance, relating to target 1: By 20xx, all countries will have adopted institutionalized and informed participation mechanisms allowing stakeholders (local authorities, NGOs, users) to influence decision-making at all relevant scales and in an integrated manner'. In the commitment session, IWA expressed the commitment of the Specialist Group on Institutional Governance to form a task group to support the professionalization of engagement processes.

Human resources capacity gaps study

At the Forum, many sessions covered capacity building components of achieving improvements in the water and sanitation sector. IWA believes in capacity building on the basis of knowing the capacity shortages and gaps, which is still relatively unknown. Therefore, IWA presented its methodological framework to nationally assess the human resource shortages and gaps within the 'Condition of Success: enabling environment'.

Additionally, it hosted a dialogue session with UNESCO- IHE, CAP-NET and GLOWS about the difficult question: how to institutionalise of human resource data collection. The agreement was reached that water, sanitation and health organisations should at least take ownership of their own data on personnel.

To keep abreast about the current human resource capacity assessments, funded by USAID, AusAid and DFID, please visit www.iwahq.org/hrcapacity or contact kirsten.devette@iwahq.org.

Improving access to integrated sanitation services for all

IWA held overall responsibility for co-ordination of the Priority for Action to 'Improve access to integrated sanitation services for all', under the umbrella of the strategic direction aimed at ensuring well-being for all. The targets put forward under the Priority for Action covered three main themes:sustained access to improved sanitation; integrated management of the sanitation chain; and planning to improve sanitation at scale.An additional target focused on monitoring as a means for service providers and regulators to improve the operational performance of sanitation and wastewater management facilities.

The resulting political commitments that came out of this process were ratified by the ministers of participating countries in the Ministerial Declaration, which is available for download from the Political Commission section of the World Water Forum website at www.worldwaterforum6.org.

In the build-up to the event, solutions for integrated sanitation were submitted to www.solutionsforwater.org and a selection were selected to be showcased at the Forum. It was clear from these presentations that there are a considerable number of innovative solutions that may play a key role towards meeting sanitation needs for all and for tacking problems related to wastewater disposal.

YWP dialogue at the Forum

The participation of the IWA Young Water Professional programme was focused on raising awareness about the role of young professionals in addressing global water challenges, and becoming 'agents of change'.

The environment is not entirely favourable for YWPs as change agents but all stakeholders have a major role to play, including YWPs. Constant innovation and practical thinking is key for YWPs, and many organisations are not offering platforms to enable YWPs to share their experiences. Solutions to water sector challenges already exist but there is limited knowledge transfer.

The main outcomes were: good leadership is key to modelling a strong young workforce; the mentors present committed to offering further support to YWPs; YWPs agreed that there is a need to demonstrate their relevance if they are to get all the support they need; and it was agreed that both the mentors and the YWPs would see how best the YWP agenda can best be pushed and provided for, especially in large forums, to allow exposure, empowerment and knowledge transfer. ●

9TH IWA LEADING-EDGE CONFERENCE ON WATER AND WASTEWATER TECHNOLOGIES

3-7 June 2012, Brisbane, Australia

Water is a hot topic in the media worldwide, there is either too much or not enough. In the aftermath of some of the worst natural disasters in recent years, the security of water supplies and wastewater services has been a challenging aspect. In all these situations we largely rely on technologies to help overcome these challenges. The 'leading-edge technologies' in these cases not only include the latest and most innovative approaches, but also the truly resilient and sustainable solutions.

The IWA's LET Conference series heads 'down-under' in 2012 to Brisbane, Queensland, Australia – a city that has faced both drought and floods over a 12 month period. We will hear from the city's utilities on how the resilient technologies have fared. There are a diverse range of global leaders speaking on everything from technology acceptance, industry opportunities, and emerging processes and pollutants, to sustainable practice. Please visit www.let2012.org for the latest information.

Email: let2012@iwahq.org
Web: www.let2012.org

IWA EASTERN EUROPEAN YOUNG AND SENIOR WATER PROFESSIONALS CONFERENCE

4-6 October 2012, St. Petersburg, Russia

Due to an increase in international cooperation in Eastern Europe and neighbouring regions, many opportunities for young water specialists are being created. It is clear that water-related problems cannot be solved separately, without considering social, economic, political and other spheres of everyday life. A new way of thinking and new holistic and multidisciplinary approaches are on today's agenda.

The present situation and experiences from the past show that when dealing with one problem in water management, many other problems should be also considered. This implies the need of close cooperation between specialists in different scientific areas to reach a really successful and sustainable improvement of the water conditions.

This YWP conference gives you an excellent chance to meet colleagues from all over the world, to share knowledge and experience, to learn new ideas and approaches related to water issues. It is a great opportunity for networking and making contacts with water professionals from different countries and different scientific fields.

In 2012 the YWP conference will focus on one of the most crucial issues in the contemporary water management – new technologies in water sector. This topic is essential for many countries and regions of commonwealth of independent states and Eastern Europe.

The main topics of the conference are:

- Advanced treatment technologies for water, wastewater and sludge
- Water reuse
- Water Resources Management
- Climate change and its influence on water resources

Email: maryna.tserashchuk@waterleau.com
Web: www.iwahq.org/1rl/events/iwa-events/2012/eastern-european-ywp.html

WATER SAFETY CONFERENCE 2012 – IMPROVING SERVICE DELIVERY AND PROTECTING PUBLIC HEALTH

13-15 November 2012, Kampala, Uganda

In Africa, the region most in need of accelerating improvements to water supply, we have the ideal location to hold the third edition of the IWA / WHO Water Safety conference, organised by IWA and NWSC and co-sponsored by WHO. The event will bring together global practitioners, researchers and decision makers to discuss best practices and emerging trends for improving the safety of global water supplies.

The theme of the conference is 'improving service delivery and protecting public health', highlighting practices and policies with demonstrable impact on service delivery levels, drinking water quality and public health.

Topics include:

- Water safety plan implementation
- Risk assessment / risk management
- Source protection
- Health impact assessments for water quality interventions
- Innovative policies and regulations for drinking water quality
- Risk-based investment planning for water supply systems
- Operation and maintenance of water supply systems
- Water safety in informal settlements
- Community managed water Supplies
- Household Treatment and safe storage
- Emerging water quality risks

Email: ws2012@iwahq.org
Web: http://web.nwsc.co.ug/iwa2012/aboutevent.html

3RD INTERNATIONAL CONFERENCE ON WETLAND SYSTEMS FOR WATER POLLUTION CONTROL

25-29 November 2012, Perth, Australia

The use of constructed wetlands in water pollution control has been a matter of considerable interest and research from the early eighties. While most of the work has focused on the use of wetlands as polishing systems and on removal of nutrients, metals and pathogens, research has also revealed their application for primary wastewater treatment ('French systems') and sludge stabilisation.

Reuse of wastewater and stormwater for non-potable purposes has become necessary due to increasing demand on high quality water. Wetlands have proven to reliably achieve efficient treatment processes, satisfying non-potable reuse requirements. This is of extreme importance in the Australian context, where most of the water is used in agriculture.

Treatment wetlands are now a well-established technology. There are several thousand wetland systems treating municipal, agricultural and industrial wastewaters in North America and Europe and a rising number of systems treating point source and non-point source pollution globally. These wetland systems have a wide variety of engineering designs, wetted areas, flow rates, influent and effluent quality, hydraulic properties and monitoring requirements. The information from this operational treatment experience can be used to form design guidelines for wetland systems. Research is necessary in areas of system longevity, pollutant removal process dynamics and system modelling.

The major aim of the Conference is to bring together researchers and professionals to discuss new developments and exchange experiences in the field of constructed wetland systems. The Conference will highlight the latest improvements and achievements in the treatment of urban storm water runoff, domestic and municipal wastewaters, agricultural and industrial effluents.

Email: K.Mathew@murdoch.edu.au
Web: www.promaco.com.au/events/wetlandsystems2012.html

DEADLINES

- **30 April 2012** for the submission of abstracts to the IWA Conference on Decentralised Wastewater Management in Asia - DEWATS (20-23 November 2012, Nagpur, India)
- **1 May 2012** for the submission of papers to the IWA Eastern European Young and Senior Water Professionals Conference (4-6 October 2012, St. Petersburg, Russia)
- **1 May 2012** for the submission of papers to the 3rd International Conference on Wetland Systems for Water Pollution Control (23-25 November 2012, Perth, Australia)

For more information about these and other conferences, visit IWA's website: ***www.iwahq.org***

MAY 2012

6th IWA Specialist Conference on Oxidation Technologies for Water and Wastewater Treatment
7-9 May 2012, Goslar, Germany
W: www.aop-conferences.de

Clean Water Through Bio- and Nanotechnology
7-9 May 2012, Lund, Sweden
W: www.kilu.lu.se/bionano2012

IFAT ENTSORGA 2012
7-11 May 2012, Munich, Germany
W: www.ifat.de/en

16th International Symposium of the Water, Wastewater and Waste Industries at IFAT
8-9 May 2012, Munich, Germany
W: http://de.dwa.de/ifat-muenchen.html

WaterVent - Funding in the Water Nexus
10-11 May 2012, London, UK
W: www.watervent.com/agenda/london-may-11th.html

World Congress on Water, Climate and Energy
13-18 May 2012, Dublin, Ireland
W: http://iwa-wcedublin.org

Earth Summit 2012
14-16 May 2012, Rio de Janeiro, Brazil
W: www.earthsummit2012.org

1st Bulgarian YWP Conference
17-18 May 2012, Sofia, Bulgaria E:W: http://2012.ywp-bulgaria.com

3rd IWA Rainwater Harvesting Management International Conference and Exhibition
20-24 May 2012, Gyeongnam, Goseong County, Republic of Korea
W: www.3rwhm.org/index.html

Water Loss Europe 2012
23-25 May 2012, Ferrara, Italy
W: www.waterlosseurope.com

Water Africa
23-25 May 2012, Abuja, Nigeria
W: www.ace-events.com

JUNE 2012

9th IWA Leading-Edge Conference on Water and Wastewater Technologies
3-7 June 2012, Brisbane, Australia
W: www.let2012.org

International Conference on Recycling and Reuse (R&R 2012)
4-6 June 2012, Istanbul, Turkey
W: http://rr2012.istanbul.edu.tr

Aquatech China
6-8 June 2012, Shanghai, China
W: www.aquatechchina.com

IWA Conference at Aquatech China - Finding Solutions to the Challenges of the Chinese Water Sector
6-8 June 2012, Shanghai, China
W: www.aquatechchina.com

ECWATECH 2012 - International Water Forum 'Water: Ecology and Technology'
5-8 June 2012, Moscow, Rusia
W: www.ecwatech.com

Regional Water Forum - EXPO APA
11-13 June 2012, Bucharest, Romania
W: www.araexpoapa.ro

Advances in Particle Separation - Science, Technologies, Practice
18-20 June 2012, Berlin, Germany
W: www.particle-sep2012.de

AWA Biosolids and Source Management National Conference
18-20 June 2012, Gold Coast, Australia
W: www.awa.asn.au/bsmconference

Ecotechnologies for Wastewater Treatment - Technical, Environmental and Economic Challenges
25-27 June 2012, Santiago de Compostela, Spain
W: www.novedar.com/ecoSTP
In this conference, wastewater treatment will be approached on a global scale, with issues around new processes and technologies being considered together with those related to emissions, economy and environmental analysis, in an integrated perspective. This event is also conceived as the closing Conference of the NOVEDAR_Consolider project 'Conception of Sewage Treatment Plant (STP) of the XXI Century', where recent works under development to face the challenges of wastewater treatment will be presented.

1st International Conference on Integrative Sciences and Sustainable Development of Rivers
26-28 June 2012, Lyon, France
W: www.isrivers.org

SIDISA 2012
26-29 June 2012, Milan, Italya
W: www.sidisa2012.it

International One Day IWA Conference on Autotrophic Nitrogen Removal: From Research to Applications at ISIDISA 2012
29 June 2012, Milan, Italy
W: www.sidisa2012.it

JULY 2012

Singapore International Water Week
1-5 July 2012, Singapore
W: www.siww.com.sg

Water Convention 2012: Water Solutions for Livable and Sustainable Cities
1-5 July 2012, Singapore
W: www.siww.com.sg/water-convention

International YWP Conference Hungary
10-13 July 2012, Budapest, Hungary
W: www.iwa.ywpc.org

INDOWATER 2012
11-13 July 2012, Surabaya, Indonesia
W: www.indowater.merebo.com

IWA Conference on Hydroinformatics
14-18 July 2012, Hamburg, Germany
W: www.hic2012.org

AUGUST 2012

XXVII Nordic Hydrological Conference - Nordic Water 2012
13-15 August 2012, Oulu, Finland
W: http://nhc2012.oulu.fi/index.html

AOGS – AGU (WPGM) Joint Assembly: HS01 Session on Geostatistics for Space-Time Analysis of Hydrological Events
13-17 August 2012, Singapore
W: www.asiaoceania.org/aogs2012/public.asp?page=home.htm

World Water Week
26-31 August 2012, Stockholm, Sweden
W: www.worldwaterweek.org

2nd Regional African Water Leakage Summit 2012 & WMD Workshop
29-31 August 2012, Cape Town, South Africa
3-5 September 2012, Johannesburg, South Africa
W: www.wrp.co.za

SEPTEMBER 2012

9th International Conference on Urban Drainage Modelling
4-7 September 2012, Belgrade, Serbia
W: http://hikom.grf.bg.ac.rs/9UDM

Nutrient Removal and Recovery 2012
23-25 September 2012, Harbin, China
W: www.IWANRR2012.org

OCTOBER 2012

IWA Eastern European Young and Senior Water Professionals Conference
4-6 October 2012, St Petersburg, Russia
Contact: Maryna Tserashchuk
Email: maryna.tserashchuk@

6th International Conference on Flotation in Water and Wastewater Systems
29 October 2012 - 1 November 2012, New York City, USA
W: www.flotation2012.org

Water Expo China + Water Membrane China
29-31 October 2012, Beijing, China
W: www.messefrankfurt.com.hk
This three-day water exhibition will cover the areas of water deemed crucial to solving China's water problems, such as water and wastewater treatment, pumps and valves, irrigation and flood prevention, and sludge treatment and disposal. Alongside the exhibition will run over 40 sessions and presentations focusing on water industry policy, planning, design and operation, which will include the 7th China International Water Business Summit, Water Quality Monitoring and Analyzing Conference, Membrane System for Water Treatment Conference, and a Water Industry Automation & Control and Information Technology Seminar. In addition, there will be tailor-made business match-making forums to increase business opportunities, and for the first time, an off-site visit is being arranged to a water plant so that visitors can experience first-hand a glimpse of what is happening in China's water industry.

NOVEMBER 2012

Water Safety Conference 2012
13-15 November 2012, Kampala, Uganda
W: www.iwa-watersafety2012.org

FUTURE IWA EVENTS

IWA World Water Congress & Exhibition
16-21 September 2012, Busan, Korea
Email: 2012busan@iwahq.org
W: www.iwa2012busan.org

Denotes an event organised or supported by IWA

A PREMIER WATER EVENT LIKE NO OTHER

Singapore International Water Week

1 – 5 July 2012
Sands Expo & Convention Center, Marina Bay Sands

Themed *'Water Solutions for Liveable and Sustainable Cities'*, the Singapore International Water Week 2012 is one of the must-attend water events in the global water events calendar. The event comprises the Water Leaders Summit, Water Convention, Water Expo and Business Forums. It culminates in the presentation of the Lee Kuan Yew Water Prize, a prestigious international award to honour outstanding contributions in solving water issues.

Water Expo (2 – 4 July)

Water Expo is one of the world's most comprehensive water trade shows on innovation, products and services, drawing strong participation from leading industry players and international pavilions.

In 2012, Water Expo's exhibit portfolio expands to include Trenchless Asia 2012; adding innovations and products on trenchless technologies to the already comprehensive mix of water-focused solutions.

Participating Key Companies	
Asahi Kasei	Moya Asia Ltd
Black & Veatch	MWH
Boustead Salcon Water Solutions Pte Ltd	PWN Technologies BV
CDM Smith	Sembcorp Industries Ltd
CH2M HILL	Siemens Water Technologies
Hyflux Ltd	Suez Environnement
Keppel Corporation	Toray Industries Inc.
Memstar	United Engineers Ltd
Mitsubishi Electric	Veolia Water Solutions & Technologies (SEA) Pte Ltd
Mitsubishi Rayon Co. Ltd	Xylem Inc.

International Pavilions			
Australia	Canada	Japan	The Netherlands
Belgium	China	Singapore	United Kingdom

Discover New Business Opportunities in Regional and Industrial Markets

Industrial Water Solutions Forum (3 July) NEW!
'Towards Water Sustainability in the Industrial Sectors'

The inaugural Industrial Water Solutions Forum examines challenges faced by industrial sectors, such as energy and manufacturing, in water management and how innovative solutions could address such challenges. Leaders from the global industry water-users can network and exchange views on the risks and challenges for large industrial water users and opportunities for current water solutions providers in industrial water management.

Business Forums (3 – 4 July)

The Business Forums offer industry leaders extensive business networking, partnership information and lucrative deal-making opportunities across key markets covering the Americas, Australia, China, Europe, India, Japan, Middle-East & North Africa and Southeast Asia.

Date	Business Forum	
3 July	Americas India	Middle East & North Africa Southeast Asia
4 July	Australia China	Europe Japan

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Join global water experts as they converge in Singapore from 1 – 5 July 2012. Visit www.siww.com.sg to register before 30 April 2012 and enjoy up to 10% savings.

Find out more about the Singapore International Water Week 2012 at **www.siww.com.sg.**

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