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# Elsewhere in *ICE Proceedings*

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**UK reservoirs face drought of safety engineers**
I. Hope
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, No. 4, November, 147

Trees have many environmental benefits, not least of which is their little-known role in reducing rainfall run-off. Research by Markus Englmeier and Miklas Scholz from the University of Edinburgh shows trees could play a much greater role in delivering sustainable drainage.

**Cheong Gye Cheon restoration in Seoul, Korea**
J.-H. Shin and I.-K. Lee
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, No. 4, November, 162–170

While much of Britain's canal and railway networks have been abandoned, the country has yet to start ripping up the roads that replaced them. But in Seoul, Korea, they have done just that. Last year saw the completion of a bold, community-driven scheme to demolish a 6 km long, 10-lane stretch of concrete highway in the middle of the city to bring the old Cheong Gye Cheon river underneath it back to life. It has created a much-needed green corridor in the post-industrial centre of one of the world's largest cities. This paper provides an overview of the £200 million project, which has become a new benchmark for urban regeneration.

**Management of rural water services in sub-Saharan Africa**
P. Harvey, J. Uno and R. Reed
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, No. 4, November, 178–184

Rural water supplies in sub-Saharan Africa generally rely on community management and have low levels of service sustainability. This paper reports on a review of rural water supplies throughout the sub-continent including results of field research in Uganda. It reveals that private sector approaches to service delivery have been implemented in a small number of cases but have demonstrated considerable potential for enhanced levels of sustainability. It concludes that the rural African private sector can only develop if decision-makers are prepared to accept the limitations of community management and the need to explore more sustainable alternatives.

**Water for the world—why is it so difficult?**
J. Banyard
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 4–10

Lack of clean water is the single biggest cause of human illness and death in the world. One of the UN's Millennium Development Goals is to halve the proportion of people lacking access to clean water and sanitation by 2015. But, while the technology underpinning water and sanitation in developed countries has been understood for nearly a century, it is proving difficult to transfer it to developing and transitional countries. This paper examines the evolution of water supply and sanitation in developed countries and identifies the challenges they are facing, including ever-increasing demands for higher quality standards, the need to replace ageing assets and demands for sustainability. It then questions how much of this is relevant to developing countries, where 'sustainability of water supply' simply means what is available today will continue to be available tomorrow.

**Ethics: making it the heart of water supply**
M. Sohail and S. Cavill
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 11–15

Water ethics is an important but frequently ignored aspect of water resource planning and infrastructure management. This paper sets out seven basic concerns for the water sector in developed and developing countries. These concerns are the water cycle, quality of life, equity, sustainability, human rights, externalities and governance. They are then used to develop ten ethical principals that should be taken into account by water professionals and decision makers if they are to achieve effective, efficient and ethically acceptable water resource management. Points for discussion are also raised on how ethics can play a more prominent role in ensuring water provision for all.

**Pro-poor concessions for sustainable water services**
M. Sohail, J. Bateman, A. Cotton and B. Reed
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 16–20

Most of the billions of people without drinking water or sanitation are very poor. While private-sector companies are becoming increasingly involved with infrastructure provision in developing countries, their contracts for water and sanitation services tend to forget the social aspects of providing services to poor people. As such, public–private partnerships in particularly poor countries are unlikely to be sustainable in the longer term and UN targets for improvements will fail to be met. Based on a four-year research project in Asia, Africa and Latin America, this paper explains how concession contracts need to be more suited to the needs, resources and aspirations of local impoverished communities—in other words, to be more pro-poor.

**Dams: setting a new standard for sustainability**
R. Bridle
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 21–25

Dams are important elements of water infrastructure and bring many benefits to society. The World Commission on Dams addressed concerns about them and practice is improving. The UN Millennium Development Goals aim to halve several unsatisfactory situations by 2015, and infrastructure contributing to their achievement should therefore be designed to halve current risks. Quantitative risk assessment methods have been developed to enumerate the safety of UK dams. Any quantitative assessment of risk necessarily raises the need to establish what risks are acceptable to society, and the work on dams has prompted the thought that acceptable risk could become an impartial, apolitical and conscionable means of establishing the standards of infrastructure that should be delivered. How the approach could be applied and developed is described.

**Trenchless technology: a modern solution for clean-flowing cities**
D. Downey
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 26–30

The Indian Government is currently using trenchless technology for construction and rehabilitation of sewers in New Delhi as part of a massive programme to clean up the Yamuna river. The work is of a similar scale and concept to Joseph Bazalgette's nineteenth century London sewerage project—the main difference being that modern urban societies, whether rich or poor, can no longer afford the disruption of major open-cut construction. This paper reports on the huge take-up of trenchless techniques in both the developing and developed world, and of its increasingly vital role in cost-effective provision and renovation of water and sewage networks in today's congested cities.

**Sharing water: engineering the Indus water treaty**
D. Birch, A. Rasheed and I. Drabu
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 31–38

When Pakistan and India achieved independence in 1947, their boundaries and the disputed state of Kashmir lay directly across the vast and vital Indus river basin. This quickly led to a still-simmering row over territorial rights and a similarly entrenched but more resolved conflict on water rights. During ten years of negotiations, which involved engineers rather than politicians and using the World Bank as mediator, the two countries finally concluded the Indus Water Treaty in 1960. This paper describes how the treaty was arrived at, its provisions for separate management and water sharing, the many, often massive, control schemes that have been built or attempted since and the lessons learned for future cross-border water disputes.

**Water mining: the Great Man-made River, Libya**
A. Kuwari
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 39–43

Libya's £14 billion Great Man-made River is one of the world's largest water-supply projects. It involves mining ancient groundwater reservoirs under the Sahara desert and piping it to the coast, where most of the country's 6 million inhabitants live. The first and largest two phases have been operating for over 10 years, two more sections are under construction and future phases will bring total deliveries to 6·6 million $m^3$ a day. This paper provides an overview of the project to date and of the many lessons learned from its construction and operation. It also compares original environmental impact projections with impacts actually experienced—which indicate reservoir depletion is proving slower than expected such that supplies should last well into the next century.

**Lesotho Highlands: the socio-economics of exporting water**
L. Tromp
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 44–49

Lesotho Highlands water project is one of the most significant and ambitious water supply schemes under construction in the southern hemisphere. Given the relatively small size of the Lesotho economy, a project of such magnitude has inevitably had dramatic effects, particularly on human settlement patterns. This paper reports on the socio-economic challenges that had to be resolved before, during and after the implementation of the £1·5 billion phases 1A and 1B, which were completed in 1998 and 2002 respectively. It also provides the latest data on project costs and the considerable income and other benefits now being received by Lesotho.

**Instituting change: regionalising the water business in Romania**
R. Wilson, C. Schoon, A. Uifalean and B. Peacock
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1– Water Worldwide Principles and Practicalities, May, 50–57

Romania's water and sewage services have until recently been provided by some 600 separate operators, many of which are small, inefficient and under-funded. In preparation for the country's accession to the EU in January 2007, a pilot programme has been underway to encourage reform of its water sector into a series of larger, more efficient and self-sustaining regional utilities—helped by the implementation of a €100 million capital investment programme. So far ten regional water companies have been set up serving 3·1 million people in 12 of Romania's 41 counties. This paper reports on the many challenges involved in introducing major institutional change in a fragmented and poorly funded water industry.

**Europe: a challenging new framework for water quality**
D. Kay, A. McDonald, C. Stapleton, M. Wyer and L. Fewtrell
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 1—Water Worldwide Principles and Practicalities, May, 58–64

By 2015 all EU member states will need to have achieved the unprecedented condition of 'good ecological status' throughout their national watercourses. This means managing not only point sources of pollution, like sewage outfalls, but also diffuse sources such as runoff from farmland. The new quality requirements are set out in the 2000 European Water Framework Directive, the most significant piece of environmental legislation so far produced by the EU. This paper describes the new legislation, its timeline for implementation and the many technical challenges now facing regulators, engineers, social scientists and environmental professionals throughout Europe as a result.

**A partnership approach to managing flood risk**
M. Crossman, D. Richardson and J. Milne
*Proceedings of the Institution of Civil Engineers—Civil Engineering*, **159**, Special Issue 2– Risk: Facing the Reality, November, 41–45

Flood risk poses a significant threat to many communities and, whereas measures can be taken to reduce the likelihood and impact of flooding, the risk can never be eliminated altogether. Insurance provides a useful means of spreading the residual risk and this paper provides a description of the UK partnership that enables insurance, backed by private-sector capital, to be made available on the basis of Government commitment to manage risks. It describes the benefits of this approach compared with that taken in other parts of Europe and makes the case for further broadening and deepening of partnership as climate change and socio-economic development give rise to increasing risks.

**Sustainable chains for rural water supplies in Africa**
P. A. Harvey and R. A. Reed
*Proceedings of the Institution of Civil Engineers—Engineering Sustainability*, **159**, No. 1, March, 31–39

Many rural water supplies in sub-Saharan Africa demonstrate high operational failure rates, particularly those using handpumps to extract groundwater. The supply of spare parts for pump maintenance is one of the weak links in the quest for sustainability and there are very few examples of sustainable supply chains throughout the subcontinent. There are a number of key reasons for this, which are specific to the rural African context. These include: the separation of the supply of pumps from the supply of associated spares; low pump density resulting in low profits; poverty and immobility among end-users; inflexible approaches to technology choice; and restrictive policies and maintenance systems. Field research in four African countries—Ghana, Kenya, Uganda and Zambia—indicated that the supply of handpump spare parts to rural areas is not a viable stand-alone commercial activity, despite many initiatives with this ultimate aim. There is a critical need for realism in the rural water sector and for implementers to move away from the perceived wisdom that the private-sector alone is the solution to the spare parts conundrum. Integrated service provision, appropriate technology choice and, where necessary, non-profit sector options provide a multifaceted solution that must be embraced if present and future rural water services are to be sustained.

**Sustainable water—lessons from the developing world**
K.-F. S. Wong
*Proceedings of the Institution of Civil Engineers—Engineering Sustainability*, **159**, No. 2, June, 55–62

By comparing and contrasting the underlying principles of sustainable water management (SWM) in England and developing countries, this paper highlights the features and limitations of current water practices in achieving long-term sustainability in England. The over-reliance on formal and judiciary institutions fails to acknowledge the complex roles of agency and socially embedded institutions in shaping water-using norms and behaviour. The minimal level of community participation does not help in building trust among water users, regulators and suppliers. Decentralisation, in the form of privatisation, does not necessarily enhance water efficiency, and the universal application of water regulations may not fit into local conditions.

**Banked realignment: a case study from the Humber Estuary, UK**
N. I. Pontee, S. C. Hull and J. R. Moore
*Proceedings of the Institution of Civil Engineers—Engineering Sustainability*, **159**, No. 3, September, 99–108

The majority of realignment schemes undertaken in the UK to date have involved breached realignment. However, banked realignment schemes can offer benefits in terms of creating habitats that have greater physical and biological connectivity with the wider estuary. These benefits are illustrated through a case study of a scheme at Welwick in the Humber Estuary, which is one of the few recent managed realignment schemes to involve the wholesale removal of the fronting flood embankment rather than the creation of breaches. In this example, the scheme design was heavily influenced by the requirement to create a compensatory mudflat habitat and, in this regard, the methods used to assess the future evolution of the scheme are described. The paper goes on to discuss the generic design issues relevant to managed realignment

schemes at other locations, including the target habitat to be created. It is suggested that the benefits of banked realignment schemes, in terms of delivering more sustainable estuary morphologies, merit increasing consideration by developers in the future.

**Decision-support tools for sustainable drainage**
M. Scholz
*Proceedings of the Institution of Civil Engineers—Engineering Sustainability*, **159**, No. 3, September, 117–125

The contribution of sustainable drainage systems (Suds) to the overall catchment dynamics of Glasgow and Edinburgh was studied. Seventy-nine sites in Glasgow and 103 sites in Edinburgh were identified for initial investigation, including a site feasibility assessment and a desk study relating to planning issues that may be relevant for subsequent future development, regeneration and retrofitting options. Detailed design guidelines were drafted for representative demonstration areas in both cities. Glasgow and Edinburgh are dominated by regeneration and retrofitting sites, respectively. Combinations of swales or infiltration trenches with ponds or below-ground storage cells were the most likely Suds options for the majority of the demonstration areas. Practical Suds decision-support tools (key, matrix and model) were developed to help identify appropriate Suds techniques for potential Suds sites. A decision-support model was developed by the author, his research team and senior planners, and provides the civil engineer with a novel practical tool to assess the suitability of different Suds techniques for a particular site with and without applying his or her own judgement. The Suds model (latest draft version on http://www.see.ed.ac.uk/research/IIE/research/environ/uw12.html) should be applied to other urban sites with similar characteristics to those in Glasgow and Edinburgh.

**Modelling coastal boundary layer flows over typical bed-forms**
M. Li, S. Pan and B. A. O'Connor
*Proceedings of the Institution of Civil Engineers—Maritime Engineering*, **159**, No. 1, March, 9–24

This paper presents details of hydrodynamics, turbulence characteristics, sediment concentrations and transport rates computed by a new three-dimensional numerical boundary layer model above typical coastal bed-forms. Comparisons are made against a large number of available laboratory and field measurements covering situations of current alone, wave alone, and combined wave and current, which demonstrate the model's ability to simulate the complex structure of flow interactions as well as the associated sediment transport processes with reasonably good accuracy. The model results are also parameterised by averaging over both bed-form length and wave period in an attempt to produce improved relations of the overall bed-form-induced roughness height and equivalent near-bed reference concentration for engineering morphological modelling. Verifications of these averaged results against some simple engineering predictors show realistic agreements along with some noticeable differences. Where differences are found, modifications are also suggested to the existing engineering formulae in order to improve their predictions for complex flows. Further model testing is also suggested to refine the constants used for the proposed modifications.

**Improved numerical modelling of estuarine flows**
D. Liang, R. A. Falconer and B. Lin
*Proceedings of the Institution of Civil Engineers—Maritime Engineering*, **159**, No. 1, March, 25–35

Three key improvements to a widely used numerical model for predicting depth-averaged shallow water flows in estuarine and coastal waters are outlined herein. They include the adoption of a new grid layout for calculating friction and viscosity, a new method for simulating flooding and drying processes and a better representation of irregular wall boundaries. Although these improvements are currently implemented in the Depth Integrated Velocities And Solute Transport (DIVAST) model, they can easily be extended to other numerical models in the framework of a finite-difference or finite-volume method on a space-staggered rectangular grid system. Much effort has been made to keep the improvements simple and efficient so that they can be used in long-term and large area simulations of estuarine and coastal flows. Numerical tests have been undertaken to verify the performance of these refinements for idealised bed forms, different beach configurations and irregular shoreline boundaries. The results show that for all conditions these refinements produce either the same or better results than the original model. Finally, the refined numerical model was used to simulate the tidal flow in a natural coastal basin. On the whole, the predicted variations in the inundation areas and the velocity fields were reproduced more accurately for different stages of the tide. At field measurement sites, the predicted water levels and velocities agreed favourably with the measured data.

**Modelling wave attenuation by submerged resonators**
T. V. Karambas and M. Gousidou
*Proceedings of the Institution of Civil Engineers—Maritime Engineering*, **159**, No. 2, June, 45–53

A system of mathematical models for linear wave propagation in a wave duct in the presence of submerged structures was developed and applied to study the dynamic interaction of the structures and the wave field. The presence of the structures and their dynamic coupling with the propagating waves was properly modelled and parameterised. Submerged structures of tubular form, double-peaked submerged structures and highly porous structures were tested. The phenomenon of resonance was revealed under certain conditions (when the structure width was of the order of half the wave length), resulting in a considerable increase of the efficiency of the structure in attenuating the incoming waves. The model produced satisfactory agreement with experiments performed in laboratory flumes.

**Modelling circulation and vertical mixing in estuaries**
W.-C. Liu
*Proceedings of the Institution of Civil Engineers—Maritime Engineering*, **159**, No. 2, June, 67–76

A laterally averaged two-dimensional model of estuarine circulation has been developed and applied to the Danshuei River estuarine system in northern Taiwan to study the changes in estuarine circulation and salinity distribution when certain parameters of the flow are varied systematically. The numerical experiments were conducted with the real geometry of the

Danshuei River system. The boundary conditions include a simple harmonic tidal oscillation and salinity forced at the Danshuei River mouth and a constant river discharge applied at the head of the three tributaries. Two internal parameters, the coefficients of vertical turbulent viscosity and diffusivity, $A_z$ and $K_z$, respectively, were taken: (a) as time varying and (b) as constant. It was found that the use of variable coefficients, $A_z$ and $K_z$, instead of constant values, has significant effects on the vertical profiles of current and salinity distributions during a tidal period. Experimental runs with different values of the tidal amplitude, the river discharge and salinity showed the effects of interaction between the tidal-driven and density-driven components. The simulation results reveal that turbulent mixing terms had substantial impact on estuarine circulation and salinity distribution. Comparisons of field data and modelling results with constant and non-constant $A_z$ and $K_z$ were also investigated.

**Solitary wave transformation, breaking and run-up at a beach**

A. G. L. Borthwick, M. Ford, B. P. Weston, P. H. Taylor and P. K. Stansby

*Proceedings of the Institution of Civil Engineers—Maritime Engineering*, **159**, No. 3, September, 97–105

A validated one-dimensional Boussinesq–non-linear shallow water equations numerical model was used to investigate the interaction of solitary waves with beaches. The numerical model requires two adjustable parameters: the bed friction coefficient and awave breaking parameter. Excellent agreement was achieved between the numerical predictions of solitary wave transformation and run-up at a plane beach with two sets of high-quality laboratory measurements: one a large number of experiments in a wave flume by Synolakis, the other in the UK Coastal Research Facility. A parameter study investigated the effect of uniform offshore water depth, bed friction and bed slope on solitary wave run-up. A uniform water depth may be associated with a continental shelf region. The non-dimensional run-up was found to be an asymptotic function of non-dimensional wave amplitude at high and low values of initial wave steepness. Both asymptotes scale as $(R/h_o)w_a(A_o/h_o)b$ where $R$ is run-up (defined as the vertical elevation reached by the wave uprush above still water level), $A_o$ is the offshore wave amplitude and $h_o$ is the uniform depth offshore of the beach. The empirical coefficients $a$ and $b$ depend on the beach characteristics. The model is then used to simulate the interaction of a full-scale tsunami event with an idealised beach profile representative of a beach in Eastern Kamchatka.

**Analysis of flows and water levels near tidal flap gate**

S. B. Mitchell, E. Tinton and H. Burgess

*Proceedings of the Institution of Civil Engineers—Maritime Engineering*, **159**, No. 3, September, 107–112

A method is proposed for assessing the impact of rising sea levels on areas upstream of tidal flap gates. These devices, designed to allow drainage of surrounding land during low water and flood defence during high water, are commonly used in areas where tidal high water level is higher than the level of the land behind the sea wall. Studies were undertaken at Pagham Harbour, West Sussex, UK, where a number of tidal flap gates are used to control the flow of water from channels carrying drainage waters away from the nearby town of Chichester. On one of these channels, water level data were collected at 15-min intervals at three sites near the flap gate and analysed in order to obtain values over each tidal cycle of maximum and minimum water levels downstream of the gate, and the time of closure of the gate. Water level was also monitored at two locations upstream of the gate. By obtaining estimates of mean fresh water discharge for each tidal cycle, and combining these with peak tidal water level, a functional relationship (in the form of a threedimensional plot) was obtained for the parameter $t_c$, the length of time in hours for which the flap gate is closed during each tidal cycle. These values of $t_c$ were also used in conjunction with mean tidal fresh water discharge to produce another three-dimensional plot showing the effect on peak tidal water level upstream of the flap gate, thus providing an illustration of the sensitivity of local flooding to varying $t_c$ under different tidal conditions. Finally an estimate was made of the likely impact of a 300 mm rise in mean sea level on $t_c$ for the same set of fresh water flow data, using a set of 'look-up' tables based on the three-dimensional plots obtained. These indicated that the frequency of local flooding was likely to increase significantly for fresh water flows greater than 0·8$m^3$/s. Although the increase in local flooding illustrated here is not thought to be a cause for immediate concern, particularly in view of the recent construction of a further tidal flap gate adjacent to the existing one, nevertheless the methodology employed is applicable to similar systems.

**Deterioration of reinforced concrete in sewer environments**

A. K. Parande, P. L. Ramsamy, S. Ethirajan, C. R. K. Rao and N. Palanisamy

*Proceedings of the Institution of Civil Engineers—Municipal Engineer*, **159**, No. 1, March, 11–20

Millions of dollars are being spent worldwide on the repair and maintenance of sewer systems and wastewater treatment plants. Microbially-induced corrosion causes damage via micro-organisms. Deterioration is caused by acid excretion which etches the surface of concrete, penetrating the mortar surface, especially in sewer systems. The mechanisms of concrete and reinforcement deterioration in sewer environments and microbially-induced corrosion is discussed in detail in this paper. A comprehensive review is given of the role of hydrogen sulphide and micro-organisms in the deterioration of concrete in sewer environments and of repair and rehabilitation measures, including the following preventative measures: (a) modification of the materials used in construction of sewer pipes; (b) coatings; (c) sewer treatments. A complete review of the microbial deterioration of concrete and its remedies is also included.

**Public health support to water supply in Kyrgyzstan**

D. Sutherland and G. T. Aitmurzaeva

*Proceedings of the Institution of Civil Engineers—Municipal Engineer*, **159**, No. 1, March, 21–28

This paper describes the main features of the Department for International Development (DFID)-funded Rural Hygiene and Sanitation Project (RHSP) in Kyrgyzstan, which is being implemented in parallel with the DFID/ World Bank Rural

Water Supply Project. The RHSP seeks to put into practice the current thinking that the health outcomes of improved water supply will only be achieved if hygiene and sanitation are given equal attention to water supply. In many cases the health benefits will only be achieved if there is a change in behaviour. A change in behaviour does not only mean change in practical hygiene behaviour by individuals but rather a change in attitude on the part of individuals, communities and the institutions that support them. The RHSP seeks to achieve this through participatory hygiene promotion in over 200 villages, providing supporting institutions with new information and techniques for health promotion, constructing improved public sanitation facilities and training the communities themselves to monitor the water quality and condition of their water supply system.

**Creating demand for urban sanitation in sub-Saharan Africa**
A. E. U. Obika, A. P. Cotton and M. Mkanga
*Proceedings of the Institution of Civil Engineers—Municipal Engineer*, **159**, No. 1, March, 29–35

Every hour, over 500 children die in Africa mainly due to diarrhoeal diseases. Human excreta is the principal cause of diarrhoea, which can be prevented by the installation and use of hygienic latrines, improved water supplies and hygiene practices. The number of people without access to basic sanitation facilities globally is over 2·6 billion, mainly in sub-Saharan Africa and Asia. The impact and public health risk of poor sanitation are more acute in urban communities as these tend to be more populated with less space to dispose of excreta and wastewater. Rapid urbanisation in sub-Saharan Africa has made the task of providing sanitation even more challenging for municipal engineers and other professionals. An action research project aimed at applying a marketing approach to the promotion of household sanitation was carried out between 2002 and 2004, with a pilot project in Dar es Salaam, Tanzania. This paper is one of three papers on sanitation marketing and discusses consumer research for the marketing of household sanitation. It outlines the process that could be used by municipal engineers, non-government organisations and others to understand the demand for sanitation in order to improve public health, particularly in low-income urban settlements. The paper concludes that understanding consumer motivations, constraints and preferences for sanitation is a key factor in increasing the demand and uptake of improved latrines.

**Drainage design: factors contributing to Sars transmission**
L. Jack
*Proceedings of the Institution of Civil Engineers—Municipal Engineer*, **159**, No. 1, March, 43–48

The water-based appliance trap seal is viewed as a standard component within any building drainage system, and provides adequate protection from the miasma present within the network and sewer connection pipework. Suitable system design ensures that the pressure response of the system does not result in excursions from atmospheric that might jeopardise recommended retention levels. Underperformance, as a result of poor system design or maintenance, is typically characterised by the ingress of foul odour—an event that, although unpleasant, was not normally associated with any particular risk to health until the severe acute respiratory syndrome (Sars) outbreak in Hong Kong where 42 fatalities were attributed to transmission facilitated by the building drainage system. A method-of-characteristics-based numerical simulation model that draws upon system specification and operation to predict airflow, transient network pressures and trap seal retention levels, and facilitates an assessment of the factors that contributed to the transmission of the Sars virus, is presented. This paper thus highlights the suitability of unsteady flow simulations as a tool for the prediction of future risk.

**Cost forecast model for sewer infrastructure**
A. El-Assaly, S. T. Ariaratnam, J. Ruwanpura and H. Ng
*Proceedings of the Institution of Civil Engineers—Municipal Engineer*, **159**, No. 3, September, 155–160

Sewer authorities are facing the onerous task of planning strategies for allocating funding levels to rehabilitate aging sewer infrastructure. Numerous modelling approaches have been developed by previous researchers that predict future condition based on various physical criteria. This paper develops a cost forecast model that employs a deterioration prediction. The deterioration model uses condition assessment data from inspections and incorporates these into a logit regression model that includes five independent parameters: age; waste type; material type; diameter; and depth. The deficiency probability generated from the logit regression model provides the catalyst for the cost forecasting model of sewer infrastructure presented in this paper.

**Use of waste tyre bales to construct a flood embankment**
M. W. Bo and A. Yarde
*Proceedings of the Institution of Civil Engineers—Waste and Resource Management*, **159**, No. 2, May, 57–64

A case study in the use of tyre bales in the design of a UK flood embankment is presented and the legal, technical and environmental issues are briefly discussed. A few major risks in the use of tyre bales in a flood prevention embankment—such as possible buoyancy of the tyre bale under water, possible piping of underlying soil and overlying capping soils due to their extremely high permeability, possible rebound of the bales upon release or deterioration of metal ties, release of unacceptable leachate to the controlled water from old tyres—were taken into consideration in the design stage and necessary steps and precautions were adopted. The use of tyre bales on the project provided a cost-effective and environmentally sustainable solution and has potentially paved the way for other applications. The pilot project scheme, which is now complete, has used around 1 million tyres, which is approximately 10% of the total number of tyres that would normally go to landfill in any one year in the UK.