



**ATSE INTERNATIONAL WORKSHOP SERIES**  
Water and Its Interdependencies  
in the Australian Economy  
**REPORT**

**THE GRACE HOTEL, SYDNEY  
22–23 JUNE 2010**





ATSE INTERNATIONAL WORKSHOP SERIES

# WATER AND ITS INTERDEPENDENCIES IN THE AUSTRALIAN ECONOMY

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WATER AND ITS INTERDEPENDENCIES IN THE AUSTRALIAN ECONOMY  
International Workshop Report

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# Executive Summary

The Australian Academy of Technological Sciences and Engineering (ATSE) convened an International Workshop on *Water and its Interdependencies on the Australian Economy*, in Sydney on 22 and 23 June 2010, with funding from the Australian Government Department of Innovation, Industry, Science and Research.

The Workshop, organised by the ATSE Water Forum Leadership Group, was attended by several international experts and 50 of Australia's most senior water scientists and policy-makers. It explored the relationships between water and the other key sectors of the Australian economy, in particular energy and agriculture. Challenges included were population change, urban growth and climate change. Speakers identified sensitivity to, and projections for, water demand to the year 2050 and the importance of external drivers, interconnections, and financial investment to support sustainability of their sector.

Discussions at the Workshop drew out a number of observations likely to have important policy implications for the future of water in Australia:

- 1** There is a need for a refreshed national water reform agenda by 2014. Compared to the valuable national Water Reform initiative of 1994 and the 2004 National Water initiative, the new agenda should be better nested within Natural Resource Management (NRM), energy, population, and food and agriculture policies. It should also provide principles to guide the many institutions and stakeholders involved so that they work together more effectively.
- 2** The hugely fragmented water research efforts currently in Australia highlight the need for a national water science strategy.
- 3** The links between water, energy, climate change, population and agriculture are complex and solid research based on systems thinking is needed to solve the problems that arise from those relationships.
- 4** Rapidly evolving technologies for the supply, recycling and manufacture of water need to be embraced in a visionary national approach to ensuring a reliable, safe and affordable water supply.
- 5** Decision-making on major water-energy-sustainability issues requires much better cooperation between scientists and policy makers.
- 6** More serious consideration of indigenous cultural, spiritual and economic values is needed alongside the economic and environmental interests of the broader community in water planning and decisions.
- 7** Governments, institutions and communities need to do everything in their power to liberate the knowledge, skills and individual leadership of all stakeholders to reflect a more collaborative, decentralised and localised water world.

In addition to these broad strategies, some specific issues were highlighted:

- the need to understand the potential imminence and impacts of the world reaching “peak phosphorus”<sup>1</sup>;
- the urgent need for nutrient recovery from wastewater;
- the need to reduce energy in domestic hot water systems, given that heating water in homes consumes four times as much electricity as that used to supply drinking water and sewerage services;
- the need for approaches on Australian issues of water, energy and other sectors to embrace “systems thinking”;
- improvements in current community participation processes, which currently leave much to be desired; and
- the benefits that would flow from a re-think and new directions on water management, noting the vital requirement for community trust.

The meeting noted that an integrated “whole of landscape” approach should be embraced – rather than using planning methods that separated water management, ecology, coastal processes and urban planning at local and catchment scales.

Participants prepared influence diagrams illustrating the interconnections between key variables linking water and other parts of the Australia economy.

ATSE will utilise the workshop findings, and in particular the influence diagram included in this report, in its new research project *Water Security: Optimisation of water management to secure Australia’s future in a changing climate – Understanding, developing and demonstrating a model of systems interactions in a national framework*. This project is one of four activities in a recently funded ARC-LASP project titled *Green Growth in Australia – examining the linkages within – and potential of – sustainable resource management to enable environmentally responsible economic growth*.

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<sup>1</sup> Phosphorus, a key component of fertilisers, is crucial for the world’s food supplies. Observers note that as reserves of phosphate begin to run out, the impacts are likely be immense – in terms of difficulties in maintaining food production, rising food prices, growing food insecurity and widening inequalities between rich and poor countries.

# Welcome from the Minister



Good morning. Unfortunately because Parliament is sitting I can't be with you in Sydney today to formally open your workshop on the important challenges our nation and our national economy face on water.

Can I first welcome to Australia those international speakers and delegates who are attending and thank you for contributing to greater shared global understanding on water matters. And I'd particularly like to congratulate the Australian Academy of Technological Sciences and Engineering for arranging this workshop. Can I say you've secured an impressive line up of speakers and participants, many of whom have been significant contributors to the progress of water reform in this nation?

Water security is front of mind for many Australians and, also for this government, it is central for Australia's future. We are investing in new water supplies for our cities and our towns, and we are improving the health of our rivers, and securing our food supplies. People from all over the world have heard about the serious situation we face in the Murray–Darling Basin and, here in Australia, the real life consequences of the state of the basin have been felt by many. Over the past 10 years, the average amount of water flowing into the river Murray was less than half the long-term annual average, and over the last three years the average amount of water flowing into the river Murray was just one-fifth of the long-term annual average.

The emerging challenge of climate change is compounded by decades of past mismanagement in the Murray–Darling Basin. Put simply, we've seen too much water being taken out of the system and we have a legacy of outdated infrastructure. Since the 1950s, Basin governments have tripled the amount of water that can be taken from the Murray–Darling River System. And in the Southern Basin around 20 odd per cent of water is lost to production because of leaky old irrigation systems.

All of this must change. And it is this change in the Basin that we began to drive as soon as we won government. We are investing over \$3 billion in buying back water – the fastest way to restore our rivers to health. And so far we have bought about 800 billion litres of entitlement. We are investing \$5.8 billion in irrigation of infrastructure, so our farmers can continue to produce food and fibre even when faced with the challenges of drought and climate change. And we've taken over Basin-wide planning and this year will see the release of the draft Basin plan that will reduce the amount of water that can be taken out of the rivers. The Basin plan is of great importance. It will be the first time this nation has put in place a limit on extractions from our largest river system based on science.

In addition to these measures, we are also investing well over \$1 billion in helping urban areas secure their water supplies, with desalination, storm water harvesting and recycling. All of these measures combine to form our long-term Water for the Future plan – a plan that recognises that our communities and our economy, and our environment, all depend on how we use water. It is a plan built on the recognition that securing water is central to Australia's future. And I know this is a challenge mirrored in many countries around the globe.

So I wish you well in your deliberations on this challenge, I look forward to hearing the outcomes of your workshop and I hope the discussions about water today are fruitful and productive.

The Hon. Penny Wong  
**Minister for Climate Change, Energy Efficiency and Water**

# Workshop Program

<b>ATSE International Workshop, 2010</b> <b><i>Water and Its Interdependencies in the Australian Economy</i></b> <b>22-23 June 2010, The Grace Hotel, 77 York Street, Sydney NSW Australia</b>		
<p><b>General Objective:</b> To explore the nexus and interdependencies between water and the other key drivers of the Australian economy, in particular energy and agriculture, under the challenges of population change, urban growth and climate change. The workshop deliberations will also input to a three-year Academy ARC project <i>Green Growth in Australia: examining the linkages within - and potential of - sustainable resource management to enable environmentally responsible economic growth.</i></p> <p><b>Workshop Objective:</b> To identify the principal interdependencies to be explored in the Academy project. Speakers will explore sensitivity to, and projections for, water demand to the year 2050 and the importance of external drivers, interconnections, and financial investment to support sustainability of their sector. The process of collaborative conceptual modelling will be applied by participants to identify dominant interdependencies. Subsequent investigations and research is intended to draw out policy implications for water in Australia.</p>		
PROGRAM		
22 June 2010	Day 1 – International, National and Sectoral	
	08:30	Registration and morning coffee
	09:00	Workshop opening/welcome: <b>John Nutt AM FTSE</b> Vice-President, Australian Academy of Technological Sciences and Engineering <b>Chair</b> – Michael Manton FTSE
	09:10	Formal opening (video): <b>Senator the Hon. Penny Wong</b> - Minister for Climate Change, Energy Efficiency and Water
The Commonwealth Perspective	09:15	<b>James Horne PSM</b> – Deputy Secretary, Department of the Environment, Water, Heritage and the Arts Topic: <b>Water reform in Australia: progress and lessons</b>
California	09:35	Workshop structure and outcomes sought: <b>John Radcliffe AM FTSE (Chair, ATSE Water Forum) What is the challenge?</b>
	09:45	<b>Gary Wolff</b> – Alameda County Waste Management Authority & the Alameda County Source Reduction and Recycling Board ( <b>KEYNOTE 1</b> ) Topic: <b>What frightens Californian Water Managers?</b>
	10:15	Morning Tea
		Session 2: Big Picture / Big Country Supply Demand <b>Chair</b> –Tom Connor AO FTSE
Australia	10:45	<b>Colin Chartres</b> – Director International Water Management Institute, Colombo ( <b>KEYNOTE 2</b> ) Topic: <b>International food and water security</b>
	11:15	<b>Tom Hatton PSM</b> –Director, CSIRO Wealth from Oceans National Research Flagship ( <b>KEYNOTE 3</b> ) Topic: <b>Water issues in Australia - key interactions</b>
Agriculture	11:45	<b>Laurie Arthur</b> – Ricegrower, Moulamein NSW and Ord NT, Commissioner, National Water Commission Topic: <b>Adapting Agriculture – The impact of reduced and erratic water availability</b>
Industry Economics	12:05	<b>Jim Cox</b> – Acting Chairman and Chief Executive, NSW Independent Pricing and Regulatory Tribunal Topic: <b>How a water-short future may influence the economic responsibilities of the water regulator</b>
Energy	12:25	<b>David Tanner FTSE</b> – Manager, Project and Design Engineering, Austrian Energy and Environment Topic: <b>Water supplies and demands - implications for current and future energy providers (fossil-fuel and renewable)</b>
	12:45	Lunch

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		Session 2: Big Picture / Big Country Supply Demand (continued) <b>Chair</b> – Mark Pascoe
Mining	13:45	<b>Chris Moran</b> – Director, Sustainable Minerals Institute, University of Queensland Topic: <b>How mining and water resources will interact in the future</b>
Environment	14:05	<b>Gary Jones</b> – Director, e-Water Cooperative Research Centre; University of Canberra Topic: <b>Water for the environment – key drivers and impacts</b>
Indigenous	14:25	<b>Brad Moggridge</b> – Indigenous Water Research Project Officer, CSIRO Land and Water Topic: <b>Indigenous water knowledge and connections</b>
Economics	14:45	<b>Mike Young FASSA</b> – Director, Environment Institute, University of Adelaide Topic: <b>Putting a price on water – will markets work?</b>
<b>Participant Collaboration</b>	15:05	<b>Chris Davis</b> – National Water Commissioner: Water Dependencies Collaborative Exercise – 1 <b>Introduction to collaborative conceptual modeling; the steps; an example; participants each develop their own influence diagram of water in Australia</b>
	15:45	Afternoon Tea
		Session 3: Urban Shifts – Changes in the Australian Landscape and what it means for water <b>Chair</b> – Ross Young
Population Growth	16:15	<b>Robyn McLeod</b> – Water Security Commissioner for South Australia Topic: <b>Matching rain-fed and manufactured supply to an expected growing population demand</b>
Manufactured Supply	16:35	<b>Greg Leslie</b> – Deputy Director, UNESCO Centre for Membrane Science and Technology, University of NSW Topic: <b>Manufactured supply opportunities – what will our optimum water source portfolio look like?</b>
Wastewater Management	16:55	<b>Jurg Keller</b> – Director of the Advanced Water Management Centre at the University of Queensland; Chair of Australian Committee of the International Water Association (IWA) Topic: <b>Urban wastewater management – where to in a low carbon world?</b>
Public Perceptions	17:15	<b>Blair Nancarrow</b> – Consultant, Syme and Nancarrow Water Topic: <b>The Community Driving Change: Lessons for policy</b>
<b>Participant Collaboration</b>	17:35	Water Dependencies Collaborative Exercise – 2 <b>Participants group in pairs and blend their conceptual models – what drives systems behavior?</b>
Workshop Dinner	17:55	Concluding remarks and domestic announcements, Day 1
	18:00	Close of workshop Day 1
	18:30	Depart to Royal Sydney Yacht Squadron
	19:00	Formal Welcome – NSW Chief Scientist and Scientific Engineer– Professor Mary O’Kane FTSE
	19:15	<b>Networking Dinner at the Royal Sydney Yacht Squadron</b> Guest Speaker – <b>James C McColl</b> , Research Fellow, CSIRO

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23 June 2010	Day 2 – Linkages and Interdependencies	
	08:00	Morning Coffee
		Session 4: Examples where professionals are trying to bring it all together <b>Chair</b> – Brian Spies FTSE
National	08:30	<b>Eun Namkung</b> Professor of Water Management Engineering, Myongji University, Seoul ( <b>KEYNOTE 4</b> ) Topic: <b>A whole of nation perspective – The Korean Green Economy experience</b>
Regional	09:00	<b>Mike Taylor AO FTSE</b> – Chair, Murray–Darling Basin Authority Topic: <b>Putting it together from a regional perspective</b>
Local Urban	09:20	<b>Dan Spiller</b> – Senior Director – Regional Planning & Policy, Queensland Water Commission Topic: <b>Responding quickly to a changed local environment</b>
		Session 5: Lessons from past and current efforts at integrated management <b>Chair</b> – Peter Crawford AM FTSE
Governance	09:40	Ken Matthews AO FTSE – Chair and CEO, National Water Commission Topic: <b>Our needs for better water governance</b>
	10:00	Morning Tea
		Session 5 continued <b>Chair</b> – Peter Crawford AM FTSE
Multiple Users	10:30	<b>John Williams</b> – Natural Resources Commissioner, NSW Topic: <b>Addressing water resource tradeoffs between bulk users, the environment and urban consumption</b>
Customer Expectations	10:50	<b>Shaun Cox</b> – Managing Director, South East Water Topic: <b>The Water Supplier's dilemma – meeting everyone's expectations</b>
Role of Politicians	11:10	<b>Karlene Maywald</b> – Formerly SA Minister for the River Murray and Water Security and MP for Chaffey (1997-2010) Topic: <b>The politician's responsibilities</b>
<b>Participant Collaboration</b>	11:30	<b>Water Dependencies Collaborative Exercise – 3</b> Refined and Simplified Paired Influence Diagrams Discussion on the pair-blended conceptual models to identify system delays/inertia and dominant dependencies. Participants refine their outputs.
	12:10	Lunch
		Session 6: Identifying the linkages <b>Chair</b> – Wendy Craik AM FTSE
TBL Linkages	13:00	<b>Barney Foran - Adjunct Research Fellow, Charles Sturt University</b> Topic: <b>Quantifying the triple-bottom-line linkages</b>
Urban Linkages	13:20	<b>Tony Priestley</b> CSIRO Land and Water Topic: <b>Urban metabolism – Looking at the variables and integrating them</b>
		Session 7: Workshop Conclusions and Outcomes
<b>Participant Collaboration</b>	13:40	<b>Water Dependencies Collaborative Exercise - 4</b> Proposed Critical Dependencies for Further Investigation - Presentation of examples of paired outcomes, discussion from all participants and development of a list of agreed critical dependencies for targeted future investigations.
	15:00	Afternoon Tea
		Session 7 continued <b>Chair</b> – Michael Manton FTSE
Workshop outcomes	15:20	What have we learnt from each other? – Open discussion • Learnings and outcomes from presentations and feedback • Proposed investigations for identified critical dependencies
	16:00	Discussion: <b>Workshop Statement</b> Rapporteur <b>John Radcliffe AM FTSE</b>
	16:25	Closing Remarks Moderator <b>Michael Manton FTSE</b>
	16:30	Close of workshop Day 2

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# Highlights of the Workshop

Over the two days of 22 and 23 June 2010, more than 50 people representative of the entire breadth of responsibilities in water management in Australia, bolstered by three internationally recognised contributors, came together to review water and its interdependencies in the Australian economy.

## HOW FAR WE HAVE COME

Presentations made by James Horne, Deputy Secretary of the Dept of Environment, Water, Heritage and the Arts, complemented by the dinner speech made by Jim McColl, highlighted how far water management has come since the time of the 1994 water reform and more especially the 2004 Inter-governmental Agreement on the National Water Initiative (NWI).

The audience was able to draw contrasts and parallels between Australia and California thanks to a presentation by Dr Gary Wolff from the Alameda County Waste Management Authority. Progress in California was very much determined by the outcome of specific ballot propositions put to the electorate. The only major groundwater assessment in California was undertaken in 2003 as the result of a successful ballot proposition. It was also noted that a major proposal for a further \$USD 11.1 billion investment to upgrade California's water system had been included for the 2010 November ballot, and was generating considerable divergence of opinion. By contrast, specific proposals in Australia were usually encompassed within general commitments either nationally or by specific candidates at election time.

It was evident from the workshop that there was considerable scope for Australia to share its experiences with overseas countries and its learning in water management from the past five to 10 years, an opportunity similar to that already seen by Korea which was offering to assist other countries as a result of its international leadership in implementing a policy of developing a sustainable "green economy".

A delegate asked how many "unturned stones" still need to be examined in Australian water management. Australia had seen a rapid rush to diversifying water supplies with the continuation of drought from 2002 to 2009. This in turn raised other issues such as how to balance storages supplied from a diverse range of sources and the energy consequences of using a variety of alternative source technologies, how those would in turn be influenced by costs generated by responses oriented to mitigating climate change.

## ENVIRONMENTAL WATER AND ITS MANAGERS

The Workshop was given a score card response by Professor Gary Jones on the extent to which Australia had been able to meet environmental milestones that had been developed following the 1994 water reform and the subsequent NWI. The need for ecological values and providing water for the environment had been well recognised. There had been mixed responses to returning water to the environment and adopting science to sustain the ecological values of water-dependent eco-systems. Water entitlements to meet ecological needs had achieved legal recognition, but implementation had been variable when considering the rights of other users and the potential need for reallocation. Accountabilities for environmental water were not very transparent and monitoring and adaptive management of aquatic ecosystems had been inconsistent. Demand management had been successful as a short term "fix", but achieving a strategic understanding of environmental water requirements had been uneven. Environmental, social and economic stakeholders had not been well engaged in planning environmental water provisions. The relationships with groundwater were generally not well-developed, and further attention would have to be given to social issues.

It was recognised that biodiversity was declining in California, but as no threatened species had been identified, it had been difficult to come to any absolute conclusions. However, climate change is now widely recognised, particularly in Australia, and it is likely to lead to a change in the mix of environmental assets. This raises the question of which assets we should be seeking to defend, and which ones might have to be foregone. The impact of past regulation on river flows and ecosystems was noted. The environment was now seen as a competitor to consumptive use for water, but should have a similar security of entitlement. Some speakers questioned the adequacy of skills among environmental managers in adaptive management: they should be engaged in integrative judgement and responses, not just “irrigating native vegetation”. As a consequence environmental managers need to be able to undertake their responsibilities on a landscape scale.

The Workshop participants recognised, for the first time in the case of some delegates, that cultural flows of value to the indigenous community should be identified as a separate component of river flows from those for the environment and consumptive use. Provision was made for this recognition within the NWI, but it was not widely appreciated, the indigenous community had not been well engaged and few water plans included provision for indigenous social, spiritual and customary objectives.

## URBAN WATER DEMAND

The community had generated changed expectations for the supply of water and now expected water utilities to be much more responsive to its needs. However it was noted from the recent experience in South-East Queensland that community use of water in the home and industry had become much more responsible. There had been relatively little increase in *per capita* consumption in that region with the lifting of what had previously been very tight water restrictions. There also had been a considerable reduction in inter-seasonal variability of demand compared to the pre-drought period.

It was noted in the water utility presentation that there was an increasing tendency for local supply to be secured directly by householders, virtually in competition with the water utility itself, through the increasing use of household rainwater tanks or by local storm water harvesting techniques.

## WATER MANAGEMENT SKILLS

Based on Californian experience, delegates wondered whether there was sufficient “hands-on” experience and understanding of risk among top water executives, even though technical operatives were well trained in such issues. The example of the Gulf of Mexico oil leakage was quoted as an illustration. It was also noted that it was often difficult to reach large-scale decisions and generalised truths, as much research was oriented to quite specific questions aimed at reaching specific decisions. It was seen that there could be limits in the access to science among top management and it was suggested that there should be a much stronger engagement between science and management in addressing water policy issues. This should lead to the further development of more effective adaptive frameworks.

## THE ROLE OF SCIENCE IN THE MANAGEMENT OF WATER AND ITS INTERRELATIONSHIPS

The Chairman of the National Water Commission hypothesised the need for good science and knowledge, good decision making processes, well designed and resourced institutions, the use of the automaticity of price signals wherever possible or at least stable, predictable regulation and adequate compliance and enforcement arrangements. A strategic national framework for water research was needed, including adequate transparency and providing an effective input to policy. Inevitably, societal choices must be made. This is the role of Government anywhere. Hence, decisions should be science-rich and science-adequate, but not science-determined. Choices, judgements and trade-offs will always be required. It was later noted that there were constraints within most scientific institutions on the opportunities for scientists to comment on policy options being considered by government. It was felt that scientists

needed to have a better understanding of and contribution to community thinking on water issues and how political decision-making was undertaken.

## CHANGE

The rapidity of change over the past decade, particularly in terms of communication, was noted. For example, half of the population of India now has access to mobile phones. Change is a process without beginning and without end, it involves choices, occurs in a context of uncertainty and risk and often is introduced with less than ideal information. Over many decades, managers have demonstrated skill, resilience and capacity to adjust. However, government intervention can impede, facilitate or expedite change. Masking adjustment signals can reduce innovation to the detriment of people and regions. It can be better to address social and environmental policy failures directly. Yet in many policy areas the more things change, the more they remain the same. Delegates appreciated how current policies and their responses had conspicuous parallels with those of the 1970s. They concluded that the reality of change should be accepted; recognising the net benefits of market based autonomous adjustment. Governments must focus on facilitating and expediting adjustment and managing adverse impacts on people or the environment using separate policy processes

## PRICING

The workshop recognised the importance of moving to full cost recovery and upper-bound pricing but nevertheless noted that some agencies and governments were still responding opportunistically to the “siren call” of available subsidies. Further pricing reform in such matters as postage stamp pricing and scarcity pricing of water was suggested. The risk of distortions in the market place as a result of artificially low prices for water on the basis of mis-located equity considerations, and from the provision of subsidies, was highlighted. However there was wide spread agreement that the introduction of water trading had led to very effective improvements in the management of water for rural communities, resulting in its much more efficient use, even though some aspects of the trading system needed further development.

## ASSETS

Changes have been occurring in the composition of assets and their value. The removal of redundant assets under such schemes as the Northern Victorian Irrigation Renewal Project was noted. There were also impacts on the asset base of urban water suppliers as a result of more generalised competition. Consumers themselves widely adopted water efficiency measures and installed assets to harvest their own water supplies. There were also increasing differences in the asset life of various components of urban water systems. Such items as desalination plants are usually assumed to have a commercial life of 30 years whereas the reticulation infrastructure in many cases could or even already had lasted for 100 years. Considerable concern was also expressed about the impact of the drought and water restrictions on community aesthetic assets and recreation amenities. The need to maintain them was now much more widely appreciated as the result of the extent of losses that had occurred.

## ENERGY

The relatively small amount of energy used per household for the provision of basic domestic water supply and sewage services as compared to the energy requirement for domestic appliances and hot water systems was highlighted, noting that the energy demand of water heating alone was four times that for the provision of water and sewerage services to the average home. There was also considerable discussion about embodied energy and the extent to which decisions in the future would be influenced by the price of carbon, recognising that there would be a need to seek savings “outside-the-box” by looking for new innovative approaches to energy use for water and sewerage services.

## SUPPLY TECHNOLOGY

The drought encouraged the adoption of a number of innovative approaches towards alternative sources of supply in addition to recycled water and desalination. There has been a rapidly increasing interest in the harvesting of stormwater, while there seemed to be a possible market developing for the purchase of rainwater from domestic roofs by competing water utilities. It was noted that reverse osmosis had become much cheaper, could be reliably managed and was now a mature technology. However there remained a challenge of retrofitting these new technologies and their water products to older established areas.

## PLANNING – CITY METABOLISM

Contrasts were noted between how urban areas evolved in California and in Australia. Water supply contracts in California could be transferred from serving agricultural production systems to new housing estates. By contrast, in Australia, the water entitlements for agriculture were available for purchase on the water market by other potential users which could include urban developers. The workshop considered that there needed to be much more effective integration between the planning activities of water resource managers, water supply utilities, urban design planners, and transport planners. Water, power and fresh food production needs should be integrated particularly where policies of urban infill were being adopted as an alternative to ever-expanding outer-boundary suburbs. More attention was needed to water-sensitive urban design and water use efficiency. Although there had been a rapid adoption of desalination, delegates wondered many desalination plants a city might reasonably be expected to establish, and where they could be located in relation to their footprint and the necessary brine disposal.

It was suggested that an integrated national power plan and an associated national water plan would be a desirable development when looking towards 2050. A diversity of power supplies was emerging, similar to the developing diversity of water supplies, though the latter seemed to be unduly influenced by regional and state governance constraints.

Timing could become important in relation to ensuring adoption of the best technological solutions, particularly where there were very long lead times. For example, project environmental impact statements are often developed and later accepted long after the initial capital had been raised. In the mining industry this could mean technology up to 15 years old being adopted in the planning stages because of the length of time it took to move from the initial capital raising to the full operation of a new mining venture.

A further issue raised was the variation in responsibility of officers in different jurisdictions in negotiating planning. There might be some advantage in moving towards a more harmonised approach between the state jurisdictions and the Commonwealth.

## LEADERSHIP

Leadership was recognised as an important component of the acceptance and implementation of new approaches to water management. The decisions to build the advanced water treatment plants of the Queensland Western Corridor system, the subsequent implementation of the various contracts, and the decisions as to whether to accept the water from the plants into the drinking water system were noted as examples where leadership had played a variable role. We must ensure there is reasonable consensus in the decision-making both between the public as consumers and the water corporations as service providers and also among the decision-makers themselves.

## GOVERNANCE

Considerable institutional rigidity was observed, particularly between state jurisdictions and how they undertook research, development, implementation and operation of water projects. There was

a particular need to address better research governance in terms of national priority setting and the alignment of Commonwealth and state research priorities and investments. It was also noted that there were significant disputes still extant between states in matters of governance and these added little credibility to a national approach to managing water.

## REGULATION

It appears that a number of the regulators, for example the economic regulators, the environmental regulators responsible for water flows to the environment, and regulators in environment protection authorities dealing with water quality tend to operate within their own “silos”, sometimes leading to inconsistencies of approach between and within the states. An important issue in economic regulation was to separately identify the price of water itself from the price of water services. More attention was needed on how to address pricing externalities, particularly with respect to the environment. In some areas, the legislative framework had not kept pace with the technology now being used for water conservation and supply. There remains a problem of water management associated with the mining industry in relation to co-produced water versus water used for productive use. There is considerable regulatory opacity. There should be a philosophical separation of issues of equity of pricing versus efficiency in pricing of water, with the regulatory roles separately defined. Various interrelated reforms could be linked together, for example the use of smart meters for both water and power supply. However it was important to reduce the risk of perverse outcomes.

Issues of competition, including third party access, needed further exploration although it was noted that in both the Northern Territory and the Australian Capital Territory power and water were overseen by single entities which should be able to deal with the interdependencies. Clearly, collaboration was needed when power, water and land use issues were being dealt with, whether they should be centralised or decentralised and how rural and urban uses related to such decisions and with each other.

## POLICY BY-WAYS

Several other water-related technologies were discussed. One was the diversion of water into production of crops for bio-fuels and the potential loss of efficiency that represented compared to food production. Another was the demand for water in mineral processing, particularly for flotation technologies. Attention was drawn to potential new recycling technologies together with opportunities for securing increasingly valuable phosphorus and nitrogen from sewage treatment plants.

The need to understand the interdependencies between water, energy, population and climate change was seen as crucial. For example, it was suggested that each additional Australian in the population increased the demand for water by one megalitre (ML) per year by the time all consumptive and embodied needs were considered. It was clear that some form of carbon reduction scheme would still be on the horizon in Australia and that attention was also being given to other greenhouse gases, from sewage treatment plants, as its production seemed highly variable in relation to environmental circumstances. One option suggested was an integrated water, land and carbon tax. More consideration should be given to the use of alternative, often well-established, research procedures which could be used to explore interdependencies, including mechanical modelling, life-cycle analysis, and input/output analysis.

## AGRICULTURE

It was apparent that there was considerable scope for new approaches to the way that water is currently used in agriculture. For example, the water needed to grow rice in the Ord in the first year of a new entrepreneurial initiative appeared to be much reduced and resulted in a shorter growing season before maturity compared to the traditional areas in the southern connected Murray Basin. Similarly, water use efficiency had been found to be considerably improved in the dairy industry by moving from high water-using perennial pastures in mid-summer to more strategic irrigation of annuals in autumn and spring

and the use of purchased or conserved fodders at other times. Water trading and the drought had been particularly important in encouraging farmers to develop new feed management strategies.

### COMMUNITY ENGAGEMENT AND SOCIAL ADJUSTMENT

It seemed that water-induced adjustment was likely to be a major challenge in the implementation of the forthcoming Murray–Darling Basin Plan. The Plan could result in a 30 per cent reduction in water entitlements to producers. Whilst the impacts on irrigators and major industries were reasonably well appreciated, the effects on associated small businesses in up to fourteen communities along the river system were only now becoming evident and would need further consideration and recognition. The expectations of the indigenous community would also need to be taken into account in any changes developed.

Implementation of change would necessarily depend on the perceptions created, whether they are with the introduction of recycled water for drinking in urban areas or the potential reductions in water entitlements in the Murray–Darling Basin to provide more water for river flow, the environment and cultural uses. It was evident that the relationship between researchers and politicians, whether in terms of the physical and biological sciences associated with water management or the political sciences of government, needs to be better understood. Recent experience with the public perception of potentially adopting recycled water for drinking in Toowoomba and Brisbane and interpretation of the CSIRO review of water in Northern Australia were examples discussed.

Community preferences, particularly as living standards improve globally and dietary expectations change, could lead to potentially greater water demands for food production. Equity in decision-making with fairness and trust and recognition of the community's interest in its perception of risk needed to be understood. The community should be engaged in contributing to the processes which lead to informed decision-making, albeit that decision-making is the ultimate responsibility of government. Nevertheless, it was recognised that it would be difficult to reach objective decisions based on sound science and independent policy judgments where opportunistic opposition was generated principally for political gain.

### WORLD STABILITY

It was apparent from the presentation by Dr Colin Chartres of the International Water Management Institute that poverty reduction and the more effective provision of food were essential for world stability. Although the United Nations Food and Agriculture Organisation had recently indicated that the capacity existed to increase the food capacity that serves the present 6 billion population, to meet the needs of an ultimately expected 9 billion population, it seemed doubtful whether the availability of the additional water to achieve that production had actually been sufficiently considered. In addition there were other limitations on the horizon, most notably with the likely approach of “peak phosphorus” which would result in fertiliser being an increasingly expensive input to food production systems. There was some evidence that the divide between the “haves” and the “have-nots” was expanding. It was considered that a greater proportion of overseas aid programs might be usefully oriented to the more effective and equitable governance and management of water resources.

### SYSTEM DYNAMICS AND INTERACTIONS

Workshop participants were briefed on the essentials of the dynamic systems approach to exploring linkages and feedback loops between water and other essential components of the Australian economy. They produced individual, then paired influence diagrams that were later combined into a summary diagram illustrating the key interdependencies. These will subsequently be used to identify priority areas for further investigation.

# Influence Diagrams and System Dynamics

The role of water in the Australian economy is inextricably linked to other economic sectors such as agriculture, mining and energy generation. Water management is also confounded by challenges posed by population change, urban growth and climate change, social pressures to protect the environment and lifestyles and also constrained by regulatory, legal and institutional frameworks.

One method of exploring these interactions and mutual interdependencies is by the use of influence diagrams and system dynamic models which provide a qualitative identification of links and feedbacks between different aspects of the system<sup>2</sup>.

As a workshop exercise, participants prepared influence diagrams of specific aspects of the water system in which they had expertise, then grouped into pairs and combined diagrams. These paired diagrams were later combined by the organising committee into a larger integrated systems model shown in Figure 1 (page 14).

This diagram, which is very much a 'work in progress', illustrates some of the complex links between water and other sectors in the Australian economy and society. Simplified but more quantified models incorporating feedback loops, stocks and flows and critical interdependencies can be constructed to better understand specific parts of the system.

The influence-diagram approach illustrates some of the linkages, interactions and feedback loops that need to be considered in integrated natural resource management. Figure 1 is not intended to represent a complete definition of the system but rather one view that will improve understanding and identify further critical areas and interdependencies to be explored.

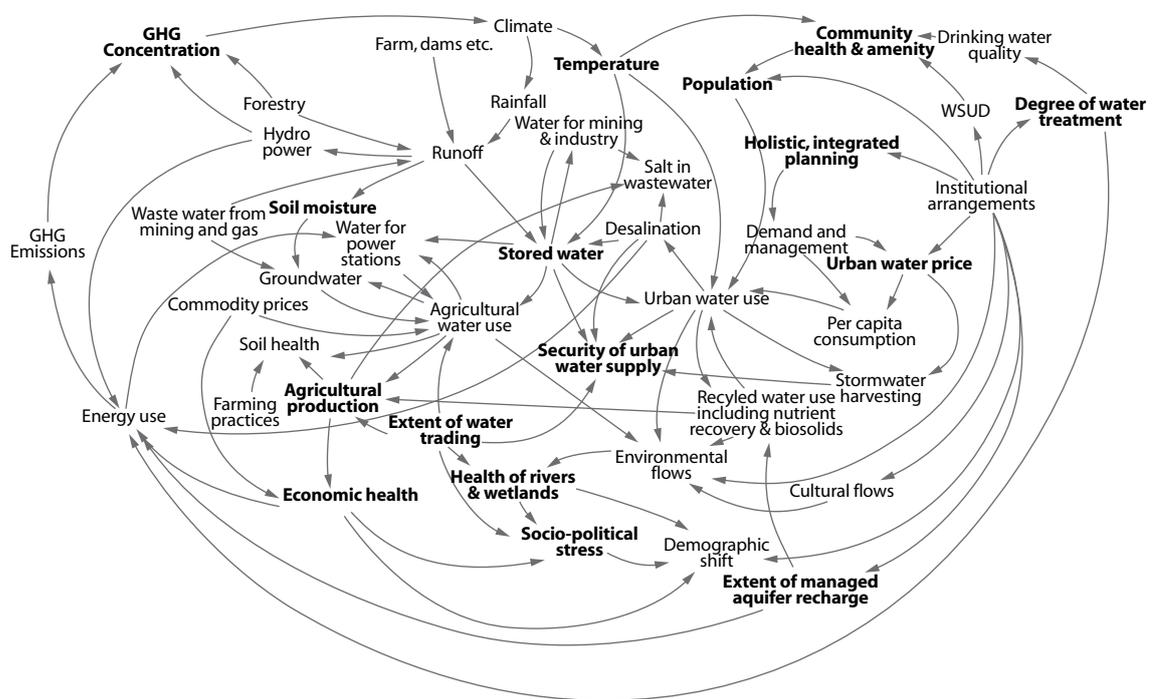
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<sup>2</sup> Barry Newell and Katrina Proust, (2009), *I See How You Think: Using Influence Diagrams to Support Dialogue*. Canberra, ANU Centre for Dialogue.

Proust, K, Dovers, S, Foran, B, Newell, B, Steffen, W and Troy, P, (2007), *Climate, energy and water: accounting for the links*. Land & Water Australia, Canberra.

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Figure 1 Influence diagram showing some of the interdependencies between water and other components of the Australian economy



## Major Issues

During the proceedings of the workshop, groups of participants were asked to compile a list of the top issues they saw for Australia in terms of water. Generally these have been brought out in the Workshop Summary but have been summarised for completeness in this report. In developing this list it was assumed that climate change and population growth are critical factors. There was also a view from this session that it was desirable to produce a media release as a communiqué from the workshop and this was completed by the workshop organisers and released subsequently. It contained the essence of the recommendations listed in this report.

A summary of the major issues raised in discussion is provided below.

- A national approach to data collection, groundwater management, desalination.
- Data types include socio-economic ones and be aligned with the decisions that need to be made.
- Recent momentum for action brought about by drought conditions should not be lost just because the drought may be perceived as receding.
- Social issues be integrated into water planning, and recognise that the future can't be 'business as usual' with incremental change.
- Primacy of integrated Natural Resource Management (NRM) – widen the current scope.
- Institutional design should reflect a systemic view of NRM.

- Appropriate alignment of power to act, definitions of and responsibilities for doing so.
- Science policy to be integrated transparently – improve science-community interactions.
- Collaborative partnerships with the community on issues such as recycling.
- Build on science and knowledge to develop plausible options; involve the community to develop solutions, for example recycling (demand, yuck factor), desalination and energy, energy-water interconnectivity, opportunities for food production in northern Australia.
- Public ‘green-ness’ and behaviour:
  - sustainability filters for community, for example GHG design standards underpinning sustainable urban systems (% target); and
  - resource use and recovery, underpinned by sound principles.
- Government and legislative frameworks need to keep pace with technological developments.
- Institutional intelligence rather than institutional design – people need to be able to operate efficiently within the system (for example, NSW’s NRC).
- Integrated policy development and strategy.
- Baseload energy be met by nuclear.
- Revisit 2004 study on recycling and reuse of water.
- Achieve awareness of trade in water-intensive materials (embodied water) and impact on stressed water systems.
- Seek three ‘quick wins’ – nutrient recovery, peak phosphorus, lower fossil energy use in domestic hot water heating.
- Ensure pricing of externalities and development of an efficient market.
- Systemic approach required – ATSE should blend its water and energy forums.
- Social expectation – ATSE to study and inform.
- ATSE to promote studies on the linkages between energy, water, food and population.
- Better public communication – the National Academies Forum may have a role.
- ATSE to provide independent expert, credible commentators in areas covered by these forums to the media.
- Need for a National Water Science and Engineering Strategy/Plan – ATSE plays a broker role.
- Suggested communiqué – include refreshed national water reform by 2015 including specific principles; national water science and engineering strategy (with more input to decision makers and public communication); more serious articulation of indigenous water needs alongside environmental interests; better designed participatory public processes.

## Next Steps

The inputs to the workshop will form contributions to a subsequent ARC Learned Academies Special Project entitled *Green Growth in Australia: examining the linkages within – and potential of – sustainable resources management to enable environmentally responsible economic growth*, in particular the first activity in this project titled *Water Security: Optimisation of water management to secure Australia’s future in a changing climate – Understanding, developing and demonstrating a model of systems interactions in a national framework*. This will be undertaken by the ATSE Water, Energy and Climate Change Forums, which will investigate the opportunity to develop a Green Economy within Australia. The Water Forum in particular will continue its work in taking forward the workshop outcomes and contributions of the workshop participants to provide vital inputs into that project.

# Abstracts

## ABSTRACTS – DAY 1

### **Water Reform in Australia: Progress and Lessons**

Dr James Horne PSM

[abstract prepared by ATSE]

Water reform has been very much on the agenda of many in this room now for well over a decade. And the whole notion of water in the economy has been very prominent over the past five years, as governments and economic actors has sought to manage uncertainties created by large and unprecedented declines in water availability: this has been the case in both the rural and urban contexts.

The list of actions that have been pursued over the past couple of years, or are being pursued, is a long one. The list includes legal, regulatory, and institutional reforms, undertaking path breaking research to understand better our resource base and options available to governments, and development of new information systems and new programs to enable a better more efficient and effect management of the resource.

The Australian Government's 10-year, \$12.6 billion Water for the Future initiative provides the framework for much of the impetus for reform. Water for the Future seeks to integrate large-scale investment with policy and institutional reforms to help make the management and use of our rivers and water resources sustainable for coming generations.

The release of the draft Murray–Darling Basin Plan in the context of the broader Water for the Future initiative will no doubt lead to a discussion around trade-offs between environmental use and other users, and the ability of communities to adjust. There is much in the Water for the Future which is explicitly about managing this adjustment, and it is an issue we focus closely on. And we should remember that water is just one part of the economic equation for industries and communities in the Basin. Exchange rates, international commodity prices, supply/demand balances, competition for labour from other industries all contribute to the ebb and flow of industries and communities. We should take care to keep adjustments in perspective.

It is clear that uncertainty increases during periods of significant change and can start well before that change takes effect affecting, for example, business investments and lending behaviour. With the Basin Plan not scheduled to be completed till 2011, and with many of its effects not starting to be felt till 2014 and later, there is a significant transition. Water for the Future's job is in part, in the interim, to offset any increased uncertainty, but there is an important role to be played by communications, not only to individual business people and communities, but to service providers such as banks. The point here is that adjustment is ongoing in our community. Many of you will know the MDBA has started the job in relation to the Basin Plan, and will increase its activity substantially when the draft Basin Plan is released. In the department, we have been engaged in town hall meetings in the Basin for the past nine months – we have done around twenty five of these, have an active e-newsletter, fact sheet and website.

## What Frightens Californian Water Managers?

Mr Gary Wolff

California's water systems provide clean, reliable water for a population of nearly 40 million and one of the largest farming and industrial economies in the world. The most important current sources are groundwater, local surface water, and inter-basin transfers of surface water. Desalination and water recycling are very small parts of the current supply portfolio, and water use efficiency potential is, in this author's opinion, largely untapped. These sources, however, will grow rapidly as population growth, urbanisation, climate change, and other factors force diversification of the supply portfolio.

California water systems, which include not just water supply but water quality protection systems, are unsustainable. Surface and groundwater quality are worsening and groundwater aquifers are widely over drafted. Surface water rights far exceed the amount of physical water available. And our water systems are energy intensive.

External drivers of change, like drought and urbanisation, are important to understand. Scenario analysis involving these and other factors, such as land use patterns and changes in irrigated cropland, have been done by the California Department of Water Resources. It finds that water use will be -3 per cent to +8 per cent of the 1998-2005 average by the year 2050. But there are parties who dispute these scenarios, arguing that either much more or less water will be needed by then.

This author will briefly present another (non-quantitative) way of looking at drivers of change and future outcomes for water systems in California. He suggests that factors like the size of future droughts, the perception that known = safe, the desire to innovate, etc., may be the more important drivers of change. There are many other factors that at least some California water managers fear. These include, for example, revenue shortfalls caused by reduced water sales, and judicial interpretation of endangered species laws. Some managers fear public misperceptions and ignorance; others fear the knowledge necessary for sound public policy but which might also harm a favored interest group. Perversely, some water supply managers are afraid of rain, because it may convince the voters they don't need to authorise the US\$10.5 billion bond on the November 2010 California ballot.

But do the fears of experts and managers matter? Public responses depend on public fears and hopes. The year 2050 is a long time from now. As Viktor Frankl wrote: "Between stimulus and response, there is a space. In that space is our power to choose our response. In our response lies our growth and our freedom."

## Global Water Scarcity: a risk or opportunity for Australia?

Dr Colin Chartres

The global population is now almost seven billion and predicted to rise to more than nine billion by 2050. Some would argue that the world is already utilising its water and soil resources at an unsustainable rate and yet, not only are we faced with an additional two billion mouths to feed, but mouths that crave a more varied and protein rich diet. Such diets require more animal feed and thus total world food and feed requirements are likely to double over the next 40 years. Under a business as usual scenario, the increased food and feed requirement means that we will require about twice as much water for agriculture as was used in 2000. However, many developing countries including India and China have just about utilised all their readily available water resources. Furthermore, some of these countries are embarking on ambitious bioenergy production schemes that will directly compete for land and water with food production. Urbanisation also competes for land and water and few countries particularly in the tropics are likely to be immune from the adverse impacts of climate change. Consequently, many countries are becoming acutely conscious of food and water security issues. The 2007-08 food crisis was not only a wake-up call in this regard, but has seen the response of some nations acquiring off-shore land and water resources to grow more food.

It is clear that we cannot continue a business as usual mentality if we are going to deal with the increasing demands for water and food. The food crisis of the 1960s and 70s was tackled successfully by the “Green Revolution” which featured new varieties, increased fertiliser use and mechanisation. There is unlikely to be such a ready fix this time round because of the continued depletion of our natural resource base. There are solutions, but these will require policy and governance changes, considerable capital investment, major capacity building, adoption of available but unused technologies and ongoing research and development. For example, there is considerable ground to be gained in developing countries by helping farmers produce more food per unit of evapotranspiration and to lift yields closer to those achieved in the west. Solutions, however, need to be holistic. This particularly emphasises the need for transboundary water management of shared resources. Developing country governments need help from developed countries to establish improved water governance and allocation systems that take into account national development strategies and will facilitate sharing water between users and neighboring countries. Irrigation systems need upgrading in Asia and expanding in Africa, but this has to be done in the context of river basin management and sharing the resource with hydropower generation. The extent to which virtual water (water imported in foodstuffs) can be used to substitute for home grown produce also needs examination so that water can go to the highest value users. Similarly, agricultural systems need to be viewed in their entirety to seek natural resource, production and energy trade-offs and benefits. If we achieve some of these goals, we can probably feed everybody in 2050, but whether this will be sustainable is an ongoing question. Undoubtedly the next agricultural revolution has to be “Blue-Green” to take into account the growing significance of water resource availability.

Australia has very significant capability in the governance and management of water resources. Similarly, Australia probably has few peers with respect to scientific data gathering, and development of water information systems that provide information on the variation in the resource and sustainable use patterns and thus better planning and management of the resource. From an Australian perspective, global water scarcity presents a risk if inadequate water resources governance and management and consequent food shortages lead to civil unrest, terrorism and conflict. However, Australian expertise in providing solutions to water scarcity also presents a major opportunity in terms of the “export” of water governance and management expertise.

### **Water Issues in Australia – what will make or break us?**

Dr Tom Hatton PSM

The two greatest national challenges facing Australia’s long-term water future are those posed by demographics and by climate. Neither of these challenges is new nor unique to this country. Australia is better-placed to secure its water future, improve water productivity and maintain environmental health than most any other nation. This is largely due to a long history of excellent anticipation of future demand and supply development, a commitment to water science and technology, and the concentration of growth in cities along the coast and near robust sources of fresh water. This tradition continues with innovations in technology and investment that are continuing to meet new demands based on water supplies from more diversified and less climate-dependent sources like seawater and wastewater.

There are, however, a set of outstanding risks that should limit how sanguine we feel about our water future. Against forecasts of an Australia of more than 30 million people with a drying climate, the following challenges need to be kept in mind:

- garnering broad, informed public support for the trade-off between water resource development and the environment;
- continuing historic trends improvements in water treatment efficiencies (both urban and rural);
- improving the intersect of urban and regional planning with water services; and
- building a better dialogue with Indigenous Australia with respect to their participation in water planning.

The complexities embodied in the above present profound challenges that go well beyond the traditional scope of engineering and water resource development. These complexities extend even to the philosophical (e.g., if a wetland would disappear or significantly degrade under a drying climate, do we have need to make any environmental water allocation?). The emerging challenges (and opportunities) find their greatest nexus in the planning domain.

## **Adapting Agriculture – the impact of reduced and erratic water availability**

Mr Laurie Arthur

[abstract prepared by ATSE]

In the new millennium Australia's farmers in the eastern states have faced the most extensive drought since Federation. There are strong suggestions that Australian farmers are facing a drying climate caused by climate change and not just a manifestation of the wet-dry cycle that has dogged Australian agriculture since its inception. Along with this has been a major reduction in runoff into our rivers and catchments. This, combined with increased interception activities like plantation forestry and farm dams, has meant that the availability of water for the Murray–Darling's irrigation farmers has been severely limited. Once-thriving businesses and rural industries are searching for ways to restructure to deal with a future with less water.

Murray and Murrumbidgee Valley rice farmers have had minimal access to water over the past four years. From a production peak of 1.7 million tonnes in 2001, only a meagre 19,000 tonnes were produced in 2008. The massive Deniliquin mill is still mothballed. The 1400 rice farmers are trying to cope with change on many different fronts including: farms and soil types that are unsuitable for anything other than broadacre irrigation; the ongoing drought; ongoing water reform; and Government entry into the entitlement market combined with state trade restrictions resulting in large fluctuations in the value of the water (34 per cent in the space of one federal tender), with a resultant drop in farm equity and the world financial crisis drying up credit availability. All these farmers are basically on their own despite attempts by government to help with drought assistance payments and on-farm efficiency programs. Their search for long-term drought strategies goes on.

In this talk, I will reflect on my own attempts to create a business model that will endure in the face of reduced and erratic water availability. Strategies I looked at included enterprise change, investment in more water-efficient technology and expanding into a different climatic region.

Investment in water efficiency is a difficult proposition. With drip irrigation costing in excess of \$5000 per hectare, a farmer must utilise the infrastructure every year to obtain a financial return. As a general security irrigator this removes one of my few advantages: the ability to opportunity crop in response to the season in front of me. My decision was to branch out to the Ord Valley, a distance of 3870 kilometre from Moulamein. Since rice farming had failed there for a variety of reasons in the early 1980s the enterprise was always going to be difficult. It would be necessary to create a rice industry of sufficient size to make it viable in a global sense. My neighbour Nick Lowing and I inspected the region and found it was blessed with the highest security water in Australia. The existing Ord Scheme uses only three per cent of the available water from Lake Argyle and the fresh agreement to fund Ord Stage 2 would give some chance of achieving a critical mass. A very appealing characteristic is that the past 10 years were among the wettest on record – a reversal of the situation found in the Murray Valley.

## **How a Water-Short Future May Influence the Economic Responsibilities of the Water Regulator**

Mr Jim Cox

This paper discusses the role of economic regulation of the Australian water industry. The change in the rainfall regime that appears to be occurring in southern Australia will result in a shift to non traditional

sources of water in urban areas. These include recycling, leakage reduction and demand management, and transfer from rural to urban use in some cities. Because water will be increasingly in short supply in rural areas both the market price for water and the regulated price of making water available will increase. There is likely to be greater emphasis both on environmental flows and on water trading.

Regulators should respond to these changing circumstances by emphasising full recovery of costs in prices, relating the usage price of water to the additional cost of making more water available and by encouraging competition and private investment where possible in the water industry. Much investment will be required and the cost of meeting higher environmental, security of supply and customer service standards will need to be recovered through prices. The affordability of high water bills will need to be considered. The water industry is likely to require a more complex regulatory environment.

### **Water Supplies and Demands – implications for current and future energy production**

Mr David Tanner FTSE

[abstract prepared by ATSE]

This article explores the relationship between the Water Supply and Demand by Electricity Generators and Energy providers. The first part reviews the current situation, describing the way in which water is used for electricity generation, the current markets for generators and the cooling options for thermal plants and the water supply considerations that need to be considered. The second part of the review will focus on the possible impacts from changing the energy mix with particular emphasis on the impact that the various forms of renewable energy will have on the power supply and the water considerations required in a water constrained market.

### **What will Future Mining Aspirations do for Water Demand, Food Production Systems, Prices and Energy Availability? How will Managers Cope?**

Professor Chris Moran

The most significant interactions between mining and water can be separated into external and internal to the minerals operation. Internally, water is used for many tasks, the dominant by volume being minerals extraction. Of significant engineering and production concern is dewatering of pits and underground mines in cases where they are below regional water tables. Externally, the main issues are competition between potential users, community perceptions and realities over impacts of water access and use, and short- and long-term environmental impacts of water extractions and releases.

The most significant uses of energy in minerals extraction are crushing, grinding and in some cases fine grinding in preparation for flotation (comminution). Comminution accounts for about 40 per cent of total energy use.

Mining operations typically disturb a relatively small proportion (about 10 per cent) of the land tenure that is held meaning that miners are also managers of extensive areas. Across the globe mining exists in all ecosystem types and socio-political domains. Therefore, in all locations there is potential for conflict over land access because so much land produces forms of carbon that are appropriated for food, fibre, fuel, shelter and biodiversity conservation/protection.

Consequently, mining and minerals production are intimately linked with strategic energy issues. The significance carbon-water-energy nexus that is just beginning to be realised internationally has been recognised by the mining industry for many years. Indeed, what is expressed by many experts as a global “problem” is an opportunity for mining. The first reaction is to see mining as a direct competitor for carbon production. However, when the business case for land production is shifted because of multiple lines of income the potential for demonstration of alternatives for land management and long term

productivity are greater. What is needed is an approach that will permit the integrated accounting of the values from multiple land uses. Current paradigms focus on comparisons and trade-offs. In my view, this is not a necessary position to take. What is required is a large scale project to map the areas of true trade-offs, find areas of synergy and get about designing effective business and production systems to suit.

In a more direct and obvious sense, water and energy are intimately linked within the industrial component of mining operations. There is no minerals activity in which water is involved that energy is not, and water is involved in almost all aspects of mining and minerals processing. However, energy is consumed where water is not involved so the situation can be considered somewhat asymmetric. It is proposed that a formally-coupled approach to water and energy accounting could present opportunities for improvements in the performance of both. Overall, it is difficult to see that energy prices will be highly impacted by changes in minerals extraction efficiency; downstream minerals processing, i.e., refining and smelting are likely to be stronger candidates. However, water prices will be affected. In areas where there are operating water markets and water is scarce, demand for water for mining has already increased process and will do so in the future. This is in line with government policy to move water to its highest value use. However, social risks arising from perception of industry driving change are not attractive to the minerals industry. Further, long term risks arise of irrigation infrastructure, for example, is stranded and cannot be brought back into use productively when mining is finished. In remote locations where water competition is minimal, costs of water are already increasing and are likely to continue. State governments are increasingly placing water access charges on mines in such locations. It is unlikely that this will change. It is somewhat difficult to interpret this in terms of national water policy, which would dictate that charges should be in line with government costs, because the mining industry tends to be a self-supplier and so an arbitrary resource access charge challenges the water reform concepts of linking water price to the value of its use through a market mechanism. Another form of market may be required to achieve this by setting a shadow price, for example.

Managers will cope because there are no alternatives to managing the system in which one finds oneself. The alternative is to shape the system towards one's own management goals or strengths. This seems an unlikely scenario given the strength of water reform policy and the value of water in mining and minerals extraction.

### **Water for the Environment – What have we learned in the past 25 years?**

Professor Gary Jones

From the first tell-tale signs in the 1970s, it took many years of research and monitoring, and reams of papers and reports for scientists to convince politicians and the public that excessive human use of water was seriously degrading river health. Moreover, that recovering water for the environment, along with better operational management of flow regimes, was fundamental to preventing future devastation of river ecosystems. By the mid-1990s the case for action became unavoidable, and in 1996 COAG published its first significant policy statement on aquatic ecosystem management and, specifically, the need to provide for water for the environment.

In 2010, Australia finds itself in the somewhat paradoxical (some might say ironic) position of having billions of dollars for environmental water recovery, yet still learning how to invest in water assets for the greatest overall ecological benefit. We are like a cashed-up stock market investor who knows they should invest in blue-chip equities, but without the technical expertise or tools to know exactly which companies are best, how much of each to own and when exactly is the right time to buy and sell, to secure the maximum return on investment. Nevertheless, we are making progress, albeit slower or with less clarity than might be desired by those with responsibility for making investment decisions. For example, the emerging 'environmental water manager' profession is gradually building a body of scientific knowledge, professional practice and networks to underpin efficient use of environmental water.

The next big step for environmental water management – indeed for all water resources management – is integration with other elements of the environment and economy, particularly the need for better understanding and planning for the interactions between water, energy and climate. Climate change is already impacting on water availability and ecological condition, and our growing urban population will ultimately demand a greater share of the available water resource. In a drying climate, getting the balance right, and using water more efficiently for both human and environmental purposes, remains the fundamental water challenge of the century.

### **Aboriginal Water Knowledge & Connections**

#### **Mr Brad Moggridge**

Australian Aboriginal people have survived on the driest inhabited continent on earth for many thousands of years, acquiring a deep and intimate knowledge of its landscape and water. They have adapted to Australia's climatic cycles and have developed the ability to find and re-find water in a dry landscape, this is made possible through a complex system of oral stories, song and dreaming. Aboriginal people value water as sacred and essential for survival. It is protected by Lore, which provides a system of sustainable management to ensure a healthy people. Aboriginal people's connection with Country does not separate individual features of the landscape, in stark contrast to non-aboriginal laws and traditions.

The term “cultural flow” is increasingly being used to describe the water flow needed to ensure the maintenance of Aboriginal cultural and spiritual connections with rivers and wetlands. Other definitions extend the term to include environmental, social and economic needs of indigenous nations. However definitions and needs may differ on a local scale. A representative definition has yet to be agreed by the 250-plus Aboriginal Nations within Australia.

Aboriginal cultural and economic values associated with water are poorly understood by water resource managers. The right and opportunities for Aboriginal people in respect to water are recognised by the United Nations Declaration on the Rights of Indigenous People. They are formally encompassed in the National Water Initiative 2004 which explicitly recognises “Indigenous needs in relation to water access and management”. However the 2009 Biennial Assessment found that it is rare for Indigenous water requirements to be included in water planning processes. A new group, the First Peoples' Water Engagement Council, has been appointed to assist the National Water Commission incorporate Aboriginal and Torres Strait Islander perspective into NWC projects and processes.

Further work is needed to clearly define what is meant by a cultural flow, or unravelling the differences with environmental flows. There is a lack of quantitative data on Aboriginal uses and values of water and identifying Aboriginal water requirements. CSIRO has a ongoing and expanding interest in Aboriginal water management within its Water for Healthy Country Flagship. Water jurisdictions need to further engage Aboriginal people in developing their water plans.

### **Putting a Price on Water – will markets work?**

#### **Professor Mike Young FASSA**

In urban Australia, governments have been reluctant to send a direct price signal to water users. As a result, people do not recognise the value or scarcity of the water resource. The reasons for this refusal to use prices to help manage water have a lot to do with politics. In much of the world, including Australia, there is a deeply held political belief that water should be used to achieve equity objectives. As a result, there is a general belief that the “right” way to ensure wise use of urban water resources in times of scarcity is to use a mixture of restrictions on outdoor water use, marketing programs designed to encourage people to take shorter showers, etc and subsidies to people interested in buying a new washing machine or installing a rain water tank. Governments have also been turning to building standards with a view to improving water use efficiency. These approaches have worked to reduce water use. In the last seven years, total water

use in Australian households has been reduced by around 17 per cent. Would a stronger price signal have made a difference to this outcome? Could the same or a better result been achieved at less cost?

Around the world, prices are known to impact on consumption and more particularly to the nature of investment decisions that determine how much water people use. As prices rise, people are encouraged to think about the cost of their actions. It is well known that when prices are low (subsidised) there is under-investment in water saving technology and over-use. Why, for example, would a struggling business bother to install a water recycling system when the cost of doing this is greater than the cost of buying subsidised water from a water utility? Similarly, why would an inventor bother to put hard earned savings into the development of a water saving device that a business will buy only if it saves them money and in an environment where water prices are subsidised installation of the device would reduce profits. Restrictions also impose high costs on some water users. If, for example, you want to maintain a garden in Melbourne or Adelaide you have to spend a fortune on rainwater tanks and or accessing groundwater. Each of these options is very expensive – much more expensive than the cost of buying access to scarce water through a market mechanism.

Contrast this situation with that found in rural Australia. In that part of the world, irrigators pay the full cost of supplying water to them and are exposed to water market. In places like the Southern Connected River Murray system where water has become scarce, over 20 per cent of water allocated to one person is sold to someone else. In systems like these, every water user is fully aware of the real value of water and acts accordingly. The same cannot be said of the situation in urban and industrial Australia. Around Australia and as agreed in the National Water Initiative, it is time for water prices to reflect the full cost of using every drop of water. For this to occur, all concessions and cross-subsidies that pervade the Australian water scene need to be phased out. At the same time, information about the amount of water used on a day by day basis needs to be provided.

Another reason for worrying about price is the cost of carbon pollution. One of the most noticeable responses to the emergence of water scarcity in urban and industrial Australia has been widespread investment in the development of desalination plants. These plants are electricity intensive. Like water, access to energy around Australia is underpriced with the result that businesses and households are being sent price signals that discourage them from taking the full cost of energy use into consideration. Two pricing wrongs don't make a right. If water users were sent a price signal that reflected the full cost of water and energy use, one would expect much more innovation and much more astute investments to be made. In particular, one would expect to see water-intensive businesses shift towards places where supplies are more abundant and more population growth to occur in these areas and less population growth in areas where supplies are limited. In the long run, the result would be a more prosperous nation and a more sustainable resource use.

## **Matching Rain-Fed and Manufactured Supply to an Expected Growing Population Demand**

Commissioner Robyn McLeod

Water for Good, a plan to ensure South Australia's water security to 2050, was launched on 29 June 2009. It contains more than 90 actions collectively designed to ensure that SA has a secure and reliable supply of water to support the community. Strategies within Water for Good are adaptive and multi-faceted so as to be resilient to climate change, demand changes and economic circumstances.

Water for Good is progressing in tandem with the 30-Year Plan for Greater Adelaide which aims to build a better planned urban environment in the context of projected economic and population growth. Amongst other things, the Plan for Greater Adelaide will significantly reduce the rate of water and energy consumption in all new dwellings.

Water for Good outlines how in the Greater Adelaide area, future supply variability will be addressed through desalination and increased water recycling, while water conservation will be encouraged through various measures that are not restrictive on lifestyle. Water for Good outlines the proposed new regulatory framework to be introduced in South Australia to modernise the current legislation and provide independence in price setting of water. Water for Good also commits to ensuring regional water demand and supply plans are developed for every Natural Resource Management region to meet their water security objectives. A strong feature of Water for Good is the adaptive planning framework that will inform future water security decisions.

## **Using Manufactured Water to Secure Urban Water Supplies: Achievements and Challenges**

Associate Professor Greg Leslie

Water authorities in Australia's mainland capital cities have increased the reliability of potable water supplies through the development of large-scale desalination plants and water recycling schemes. These projects use a range of membrane processes to manufacture high-quality water by removing contaminants from water sources that are independent of rainfall. The scale and speed of this achievement is remarkable. In the seven years from 2005 to 2012, the installed capacity of desalination has grown from 45 to 500 gigalitres per annum (GLA), while over the same period the volume of recycled used as a percentage of total water demand has grown from less than five per cent to 15 per cent. In years to come the development of this infrastructure to secure urban water supplies will be viewed as one of the first major responses to climate change. However, the expanded use of manufactured water is attended by several challenges, including the management of these new assets and attended by debate on the carbon footprint of the desalination plants and a search for ways to offset the additional greenhouse gas emissions from the water sector.

Essentially, there are three options that can be used to reduce the GHG emissions of a desalination plant: improving the energy efficiency of the desalination process; developing or purchasing carbon credits; or reducing energy consumption within the overall water sector.

The approach adopted for the three largest desalination plants in Sydney, Perth and Melbourne has been to purchase carbon credits generated by the production of renewable energy. The purchase of carbon credits from reforestation and other forms of managed plantation was deemed infeasible. Short-term technology solutions, such as the use of energy recovery devices have been fully exploited and have reduced power consumption from 5.0kWh/m<sup>3</sup> to 3.3kWh/m<sup>3</sup>, while other technical solutions such as segregation of lead element permeate, or targeting less stringent water quality targets for TDS and boron has only minimal impact on the overall energy requirements.

The one area that has not been fully explored or exploited is the analysis of options to reduce the energy impact of the water sector by achieving efficiencies in the amount of energy associated with domestic use of water and the treatment of wastewater. For example, the conversion of domestic electric hot water heaters to solar or gas systems can achieve a greater reduction on a community's carbon footprint than any technical solution. More importantly, it does not lock up limited sources of renewable energy that would otherwise be available to other sectors of the community and economy. This is important in Australia, because the energy requirements of the water sector only account for five per cent of the country's power consumption. It is questionable if the allocation of limited resources or renewable energy in a sector with such a small demand is good policy. Moreover, if the price of energy is allowed to move with market forces in a carbon-strained economy, the unit cost of desalinated water will increase more than the cost of alternative water supplies because of the higher sensitivity of the O&M costs of desalination to movements in the price of power.

## **Urban Wastewater Management – Where to in a resource-constrained world?**

Professor Jurg Keller

The increasing pressure from diminishing resources and emission reductions will have a direct and lasting effect on urban wastewater management. With the growing awareness of the need to achieve “more from less” in future, a range of new factors are influencing the development of the urban water systems. Many of these are directly linked to broader global trends, particularly on energy reduction, greenhouse gas emissions and resource recovery concepts.

These factors are already driving the developments in the water industry, with direct implementations likely in the next five to 10 years. This talk focuses on the key issues in four major developments:

- wastewater – our new water resource;
- energy recovery – put into context;
- nutrients – the next focus; and
- direct greenhouse gas emissions – known and emerging challenges.

The industry is well aware of many of these developments and has taken the lead on a number of fronts. This will provide some valuable opportunities for innovation and new concepts that go well beyond these key factors and even re-evaluate the way the water system integrates with the broader urban structure and function.

## **The Community Driving Change: Lessons for policy**

Ms Blair Nancarrow

With the onset of climate change and ever expanding urban populations, the ongoing provision of fit for purpose water supplies to meet and manage demand is a growing challenge for water utilities. Doing things differently is now a necessity for government and natural resource managers and not just an indulgence for the few who can afford to be innovative. Yet it is frequently said that the greatest impediment to change is gaining community acceptance. The community is criticised for not changing behaviours in the ways that they say they will. But maybe the reasons for slow behavioural change are not the fault of the community but issues for managers and policy makers. The community wants leadership, but they also want decision makers to include their ethics and values in change programs and new policies. Therefore, understanding what decisions are behind community acceptance is imperative if new policies and alternative water supply systems are to be accepted. Too often the social variables are criticised as being soft and emotional and too difficult to incorporate in decision making processes. Yet they are measurable and reliable, and are as concrete as market sentiment which is readily accepted as affecting how a market operates. If the future challenges are to be met, then the community must be considered as partners and not as impediments, and the soft variables need to be understood and addressed.

## **The Challenge of Change**

Mr James McColl

There is nothing so constant as change. It's a process without beginning and without end. Whether at the personal (partner, car, hairdo), organisational, or institutional and policy level, it involves making choices (change and choice go together), in the context of uncertainty and risk and generally with less than ideal information. Making these decisions is often difficult and challenging.

Much of change and adjustment is autonomous, mainly driven by market forces, and outside the direct control of government. Within this context, the impact of two water policy changes arising from the Water Reform Agenda 1994 are explored; the separation of water from land and the adoption of water trading (enabling/facilitating change), and the reallocation of water to the environment (one of the drivers of change). Mention is also made of lessons provided by experience in rural and agricultural adjustment programs, including comment on some aspects of the role of government.

## ABSTRACTS – DAY 2

### **A Whole of Nation Perspective – the Korean Green Economy Experience**

Professor Eun Namkung

Korea's "Low Carbon Green Growth" program is a vision for the next 60 years that is focused on a paradigm shift to balance economic growth and environmental conservation. Green growth is a virtuous cycle of the environment leading economic growth and economic growth improving the environment.

The three elements of green growth are maintaining sound growth while minimising the use of energy and resources; using the same energy and resources while minimising environmental pollution; and the development of green technology and clean energy as new economic growth engines. Green growth will reduce Korea's vulnerability to changing climate, reliance on imported energy and address declining economic growth.

The "Green New Deal" announced in 2009 commits expenditure of 107 trillion Korean Won (about US\$93 billion) by 2013 in nine key projects including river revitalisation, catchment management, green transport, forestry, green homes and clean energy. A five-year collaborate strategic implementation plan between government, research institutions and the private sector has been developed and is supported by government investment of two per cent of GDP in the next five years. The major objectives of this plan are low-carbon society and energy security, green engines for growth and enhanced quality of life and international leadership.

Following a year-long process to build national consensus, Korea has set an aggressive 2020 midterm goal for 30 per cent reduction on greenhouse gas production compared to business as usual (BAU), or four per cent below 2005 levels. To achieve this, Korea is partnering in international programs such as the East Asia Climate Partnership, the Asian Forest Cooperation Organization and the Global Green Growth Institute.

One of the major green deal projects is the Four Major Rivers Restoration Project (Han, Nakdong, Geum and Yeongsan rivers) and will invest US\$19 billion in water management to protect against flood damage, improve water storage, develop river communities and public spaces, improve water quality and restore ecology and biodiversity.

On the commercial front, Korea has launched the Eco-STAR project as a national R&D effort to develop and commercialise environmental technologies that can compete on a global market. Current projects include drinking water and wastewater treatment, aquatic ecosystem restoration and waste-to-energy and greenhouse gas reduction.

### **Putting it Together from a Regional Perspective**

Mr Michael Taylor AO FTSE

[abstract prepared by ATSE]

The Murray–Darling Basin produces one-third of Australia's agricultural production and hosts three-quarters of Australia's irrigated cropland. Water is arguably its most important resource. Dams were first built in the 1880s to support reliable transportation. After prolonged drought, the Murray–Darling Basin Commission was formed in 1915 to construct further dams and locks and develop water-sharing plans for the River Murray and its tributaries. Regional development expanded after the two world wars and water policy continue to evolve. Commonwealth and State governments, working through COAG, have implemented significant reforms over the past 20 to 25 years including salinity management and caps on water extraction, and the Water Act of 2007 and subsequent legislation established the Commonwealth as manager of environmental water entitlements. These plans aim to address systemic over-allocation and

unsustainable irrigation extraction. A key challenge will be to manage social change and assist regional and rural communities in making the transition to a sustainable future.

The Murray–Darling Basin Plan, due to be released for consultation in 2010 and implemented in 2011, will underpin the integrated and sustainable management of water resources in the Basin. The Basin Plan will provide a framework for setting environmentally sustainable limits on extraction of surface water and groundwater from the Basin.

A robust plan with sound policies should stand the test of time for the next 40 years and be able to adapt in changes to climatic conditions.

The largest social impacts will be on rural communities. While large irrigators and large businesses are well placed to adapt to changes in commodity prices and climate variability and have a solid track record in modernising infrastructure and are experienced in water trading, smaller businesses and service industries and local communities may face declines in economic viability. The Basin Plan will take into account the impact of environmental protection and restoration on individual communities, industries, regions and the wider economy.

## **Responding Quickly to a Changed Local Environment: SEQ experience**

Mr Daniel Spiller

Southeast Queensland has recently experienced major drought conditions that coincided with rapid growth in population. To respond to this challenge, the Queensland Water Commission has developed the Southeast Queensland Water Strategy 2010, which is designed to provide a sustainable, efficient and secure water supply to meet variable climate and growing population for future generations. The Strategy ensures sufficient water will be available to support a comfortable, prosperous lifestyle while meeting the needs of urban, industrial and rural growth and the environment.

The key elements of the strategy are demand management, meeting community expectations, diversifying water supplies and improving environmental outcomes.

Residential water use has halved from pre-drought levels to as low as 140 to 160 litres per person through a combination of incentive schemes, restrictions and a social marketing campaign. The SEQ Water Grid consists of a complex interconnected system of 22 dams, 35 weirs, 14 groundwater sources, 46 water treatment plants and 63 wastewater treatment plants, and an increasing focus on climate-resilient sources such as desalination and water recycling. Explicit objectives include average total consumption of 375 litres per person per day, restrictions only once in every 25 years and a 15 per cent reduction in total consumption. Work is underway to better understand variability between households and social drivers.

Integration of urban design and infrastructure planning, wastewater and stormwater management, collaboration and bottom-up innovation all assist in responding to population growth. Local supplies such as rainwater tanks, recycled water schemes and stormwater harvesting supplement the bulk water supply and reduce overall demands on water supplied from the grid, and reduced consumption effectively defers the need for new water sources. The SEQ Water Grid will become increasingly energy-intensive over time, due to the operation of manufactured water sources and interconnecting pipelines.

Technological solutions are only part of the solution. Behavioural and social attitudes and community trust are critical to the success of long-term water management.

## **Our Needs for Better Water Governance**

Mr Ken Matthews AO FTSE

Good governance arrangements are a critical success factor for good water management. Good governance includes: an agreed agenda; quality institutions; good decision-making processes; and strong water policy and water management “capacity”.

The best governance arrangements use science and knowledge to underpin decisions. Good governance emphasises transparency – including exposing trade-offs. Good governance arrangements keep pace with technology and change and they “entrench innovation”. The best water governance arrangements are designed to a long-term national strategic framework (more than just the Murray–Darling Basin). They are nested in wider natural resource management, land use and regional planning. They recognise interdependencies such as the nexus between water and energy policies and the way such policies interact and interfere with each other.

Some problems with current national water governance in Australia include:

- the constitutional division of responsibilities for water;
- State-State bickering and parochialism;
- the separation of water management from natural resource management; and
- the separation of water management from climate change action.

There are specific governance problems with Australia’s national water science arrangements. Australia currently has no national water science strategy. Priority setting processes are ineffective. Budget setting processes are flawed. There is fragmentation, overlap and duplication and there are difficulties in cross disciplinary cooperation. The links between policy and science and science and policy are not strong enough. Basic research is vulnerable. The efforts of Commonwealth and State governments are poorly aligned.

There are eight core responsibilities of governments in water:

- 1 Set and enforce health and safety regulations.
- 2 Set and enforce environmental protection standards.
- 3 Set and regulate water market arrangements.
- 4 Establish necessary institutions (for example, environmental water managers; water data and information custodians).
- 5 Regulate prices where markets fail and the benefits of intervention outweigh the costs.
- 6 Harmonise cross-border arrangements to eliminate distortions.
- 7 Integrate water planning into urban planning, regional planning, natural resource management planning and international obligations.
- 8 Introduce equity where markets don’t.

## **The Future of Catchment Management: Addressing Water Resource Tradeoffs between Bulk Users, the Environment and Urban Consumption**

Dr John Williams

Catchment Management into the future is challenged with the task of integrating water resource use of rivers and groundwater systems with natural resource management of the ecological and biophysical functioning of the whole catchment. Currently the water and natural resource management planning and actions in the catchment are usually conducted under parallel and disconnected management processes.

All Australian states and territories have planning processes for:

- the management and sharing of surface water and groundwater resources through regulation and investment. The resultant plans that are variously called water sharing plans, water management plans or water allocation plans are usually statutory in nature; and

- the maintenance and improvement in the condition of land and water resources and ecosystems through investment incentives and regulation particularly of vegetation management. These plans that are referred to as catchment management plans, catchment action plans or natural resource management plans are usually non statutory.

Future Catchment Management will need to evolve so as to align and integrate these activities. This could provide the institutional frame for water resource use for irrigated agriculture, mining, urban communities and industry while maintaining water flow in these ecological systems consistent with healthy and sustainable biodiversity and ecosystem function. It is expected that this will be particularly important to the future Basin plan for the Murray–Darling. Catchment ecosystems such as wetlands and flood plain forests are the ecological engine room for the river and groundwater systems. The river systems cannot in most instances be maintained in ecological health when the stream or groundwater is disconnected from the vegetation which is the primary producer for the river ecosystems.

Currently these two separate planning processes are not only disconnected they are also not connected to the land use planning mechanisms within urban and peri-urban development. These disconnected planning mechanisms all overlap in the provisions relating to the maintenance or improvement in the condition of freshwater aquatic ecosystems within rivers, aquifers, wetlands, estuaries and near-shore marine environments.

To address the fundamental problem in water resource tradeoffs between bulk users, the environment and urban consumption it is critical that catchment management evolve to integrate the statutory and non-statutory planning mechanisms so that water resource use and natural resource management are effectively aligned and integrated with each other and also with the land use planning for urban and peri-urban planning. This will require large-scale institutional change to bring these types of plans into one combined process.

For our societies which are confronted by very high climate variability and the anticipated impacts of climate change it is critical that future Catchment Management be reformed.

### **The Water Supplier's dilemma – meeting everyone's expectations (A retailer's perspective)**

Mr Shaun Cox

South East Water is one of three retail water companies that provide water and sewerage services for Melbourne. Climate change over recent years has presented a key challenge, due to reduced water sales combined with higher prices, increased competition and the risk of stranded assets. Traditional approaches used by water retailers (reliance on climate-dependent water sources, limited stakeholder involvement, and exclusive reliance on water sales for financial viability) are no longer optimal.

South East Water has developed six strategic priorities to respond to this changing business environment – business growth, organisational capability, integrated water management, customers and community, service delivery and influence and leadership. An example of our approach is the Integrated Water Management Strategy for Melbourne's South East, which incorporates the 3600km<sup>2</sup> Bunyip Catchment. This strategy involves integration of the total water cycle, land use planning and other sectoral interests (transport, energy), urban and rural water users, decentralisation or centralisation of systems and collaboration with a wide variety of stakeholders – water industry, community, government, environmental and business groups.

Our vision for integrated water management encompasses two key goals – “sustainable region” (systems thinking, reduced footprint, conjunctive use of assets, healthy community living in harmony with the environment), and “productive region” (support a diverse economy, protect soil resource, co-locate industries and build system resilience).

The overall objective can be described as “Water supporting sustainable communities”. Levels of service will be determined by community and environmental needs, dispersed accountability commensurate with ability to manage risk, community mindset, enabling regulatory frameworks and real-time access to transparent and robust information.

## **The Politician’s Responsibilities**

Ms Karlene Maywald

During the course of this forum we have explored the nexus and interdependencies between water and the other key drivers of the Australian economy. We have discussed the need for significant reforms in relation to water policy in particular. We also know that we need to ensure our communities are well equipped to meet the challenges that population growth and climate change will bring.

The role of the politician is ultimately the most significant in ensuring that the changes to policy that are required can be implemented. Many a politician has gambled and lost on the promise of delivering substantial reforms. It is inherent within our communities to fight change. It is also inherent for local communities to demand change but not at their own expense.

So what are the keys to getting the policy right and then actually being able to deliver the reforms necessary to implement good policy? Some of the political and community issues that need to be considered and the challenges that need to be overcome include:

- ensuring that the public is well informed of the issues, especially one as complex as water;
- the framework of the reform is robust, the processes are transparent and defensible and the science is excellent; and
- acknowledging the political science aspect of the policy and that compromises between the environmental, agricultural and socio/economic sciences are highly likely.

This talk will address these and other relevant political issues.

## **Water and Its Interdependencies: The Triple Bottom Line**

Mr Barney Foran

Seen through the lens of whole economy analysis using environmentally extended input-output analysis there are six obvious macro-themes as follows:

- personal affluence in many forms drives water requirements in a ‘full chain’ or ‘life cycle’ context, with each Australian requiring one megalitre per year of managed water embodied in their consumption basket of goods and services;
- less affluent citizens get by on 0.5ML per capita per year, while most affluent consume 1.5ML per capita per year; a bare minimum of ‘basic needs’ is about 0.6ML per capita;
- as well as running a persistent monetary deficit in our international balance of trade, Australia runs significant deficits in its trade of embodied water, embodied greenhouse and ecological footprints. Thus we are persistently in the red in our financial accounts as well as our natural resource accounts;
- national expectations that economic growth and expanding affluence will continue, and that Australia will house 35 to 50 million people in the next 50 years, will thus require at least a doubling of managed water supply to around 40,000GL per year in a period when we expect less catchment runoff in areas where people mostly live;
- water use efficiencies and product substitutions will help reduce this managed water target, along with increasing imports of fruit, vegetables and dairy products from water-rich countries such as New Zealand. This is somewhat a zero-sum game as efficiencies saturate and input substitutions (for example, grain for grass in dairy) will increase impact elsewhere (for example, energy or land); and
- water realities are strongly correlated to greenhouse emissions (global change) and land disturbance (biodiversity decline) where the ‘full chain’ measures for affluent consumers have high contents of

managed water, greenhouse emissions and ecological footprints. There is a strong technical rationale, though little political reality, in the case for integrated carbon-water-land taxation of goods and services.

## **Water/Energy Connections in Urban Metabolism**

Dr Tony Priestley

There is increasing recognition of the close interconnections between energy use and water consumption in urban areas. What is not commonly recognised is that these interconnections also include the production and consumption of food and the handling of nutrients in fertiliser production and wastewater discharges. This presentation draws on the concept of the urban metabolism as an analytical framework for identifying and understanding the interplay of these different elements.

These considerations are illustrated by reference to a CSIRO/WSAA study on energy consumption in the provision of urban water services and a CSIRO study for Melbourne Water on the flows of carbon, nitrogen and phosphorus through Melbourne's sewerage system. Consideration of an impending peak in worldwide phosphorus production and the significant energy implications involved in the manufacture of nitrogenous fertilisers and their subsequent disposal in wastewater point to the necessity of understanding all of the many complex interactions involving water. A number of methodologies can contribute to this understanding, but the concept of urban metabolism appears to provide a unifying analytical framework.

# International Speakers

**DR COLIN CHARTRES**

Director General

**International Water Management Institute**



Colin Chartres is Director General of the International Water Management Institute (IWMI). IWMI is one of the 15 research centres of the Consultative Group on International Agricultural Research (CGIAR). He has 30 years' experience in research and policy reform in natural resources management in Australia and a range of developing countries.

At IWMI, Dr Chartres leads a team of international scientists working on future water availability, agricultural water productivity improvement, reuse of wastewater in agriculture, ecosystem services, and water governance and management.

Prior to joining IWMI in 2007, he was Chief Science Advisor to Australia's National Water Commission where he focused on ensuring reform processes were based where possible on scientific evidence. Previously he held senior research and management positions with CSIRO, the Bureau of Rural Science and Geoscience Australia and has also worked in academia and the private sector.

**PROFESSOR EUN NAMKUNG**

Professor – Department of Environmental Engineering and Biotechnology

**Myongji University**



Eun Namkung is currently a full professor in the Department of Environmental Engineering and Biotechnology at Myongji University in Korea. He is also Director of the National Water R&D program (Eco-STAR Project) which is supported by Ministry of Environment (MOE) in Korea. His past career includes Director General of Water and Wastewater Works in Korea MOE and Asia Pacific Regional Chief Environmental Officer of Proctor and Gamble (P&G) Company.

He received his MS and PhD degrees in Environmental Engineering from the University of Illinois, Urbana-Champaign, Illinois, USA. He is also a full member of Korea National Academy of Engineering.

MR GARY WOLFF  
Executive Director

**Alameda County Waste Management Authority / Alameda County Source  
Reduction and Recycling Board**



Gary Wolff, is the Executive Director of StopWaste.Org, a joint powers authority composed of 17 local government agencies in Alameda County, California, located on the east side of the San Francisco Bay. StopWaste.Org is the solid waste planner and county-wide implementer of programs that serve the 1.5 million residents and 60,000 businesses of Alameda County.

Dr Wolff is an expert in the economics and engineering of resource use, including water supply, water quality, energy, and materials management. From 2001 to 2006, he served as principal economist and engineer for the Pacific Institute for Studies in Environment, Development and Security in Oakland, California. From 2006 to 2009 he was Vice Chair of the State Water Resources Control Board, and previously served as a member of the San Francisco Bay Regional Water Quality Control Board.

Dr Wolff received his Doctoral and Masters degrees in Resource Economics from the University of California at Berkeley, his Masters Degree in Civil and Environmental Engineering from Stanford University, and his Bachelors Degree in Renewable Energy Engineering Technology from Jordan College. A publications list is available upon request.

# Australian Speakers

**MR LAURIE ARTHUR**  
Commissioner  
**National Water Commission**



Mr Arthur is a rice farmer in the Murray Valley in NSW and in the Ord Valley in Western Australia. He is a National Water Commissioner and is chairman of the NFF's Water Committee. He is also a director of Sunrice. He has served as President of the Ricegrowers Association of Australia and in the 1970s he graduated in Agricultural science from the University of Melbourne.

**MR JIM COX**  
Chair  
**Independent Pricing and Regulatory Tribunal**



Mr Cox is the Acting Chairman of the Independent Pricing and Regulatory Tribunal of New South Wales and Chief Executive Officer. Mr Cox has held positions with the Reserve Bank of Australia, the Department of Prime Minister and Cabinet and the Social Welfare Policy Secretariat of the Department of Social Security. He was a Principal Economist at the Office of EPAC from 1986–89 and from 1989–92 was a consultant to the NSW Cabinet Office. Mr Cox has been Principal Adviser to the Government Pricing Tribunal of NSW since 1992 and a Member of the Tribunal since January, 1996.

Mr Cox was a visiting fellow at Monash University during 1985 and assisted the New Zealand Government with social policy changes during 1991. He has written extensively on economic and social policy issues.

**MR SHAUN COX**  
Managing Director  
**South East Water Limited**



Mr Cox is the Managing Director of South East Water Ltd, a metropolitan water retailer with approximately 1.3 million customers. Prior to this, he was Director of Gold Coast Water for 12 years. He holds a degree in Civil Engineering and a Masters of Engineering and Technology Management.

Mr Cox's career and organisational focus is on sustainability, and integrated planning – a key underpinning of sustainability. He is a Board member and past Chair of the Water Services Association of Australia (WSAA), Australia's peak national urban water industry body, representing some 15 million customers through its members. He is also a member of Engineers Australia and an Adjunct Professor at the University of Queensland. He

participated in the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) working group looking at Water for our cities. PMSEIC is the Australian Government's principal source of independent advice on issues in science, engineering and innovation.

**MR BARNEY FORAN**

Adjunct Research Fellow

**Institute for Land, Water & Society, Charles Sturt University**



Mr Foran has degrees in agriculture and ecology which led to professional eras spanning rangeland ecology, agricultural systems, environmental science and long term analysis of Australia's physical economy. He led research teams in CSIRO's Resource Futures group which produced long term analyses of Australia's physical economy focusing on human population (Future Dilemmas), marine fisheries (Fish Futures), land and water (Decision Points) and a triple bottom line analysis of the Australian economy (Balancing Act).

Linkages between the big picture sustainability issues of energy, greenhouse, human population, lifestyle, water, biodiversity and land use are major interests.

The current focus is future designs for Australia's economy that will ensure moderate rates of economic productivity and energy security combined with the rapid transition to a low carbon economy. The Powerful Choices study testing some of these options was released in 2009 by the now defunct Land and Water Australia R&D agency.

**DR TOM HATTON PSM**

Director

**CSIRO Wealth from Oceans National Research Flagship**



Dr Hatton leads a national team of multidisciplinary researchers delivering science to help Australia access the full potential of economic, environmental and social wealth derived from understanding and using our oceans. His research portfolio includes:

- ocean-land-climate interaction, including ocean and climate modelling and forecasting;
- subsea oil and gas exploration and recovery;
- sustainable fisheries;
- integrated management of competing uses of marine and coastal environments;
- development of novel marine industries; and
- marine biodiversity and conservation.

He has more than 25 years of research experience, nationally and internationally, in a broad range of land and water related disciplines including forest productivity, ecology, bushfire science, ecohydrology, water allocation, salinity and catchment hydrology. He has significant expertise in building and managing teams with diverse skills to solve resource management issues.

Dr Hatton was Director of the CSIRO Water for a Healthy Country Research Flagship prior to his current position. He chairs the Australian Government's State of Environment Committee and the National Centre for Groundwater Research & Training Advisory Board. He is also a Science Advisor to the Northern Australia Indigenous Land & Sea Alliance's Indigenous Water Policy Group, and a member of CSIRO's Indigenous Engagement Strategy Steering Committee. Dr Hatton holds a

Bachelor of Science (Range Science) and a Master of Science (Natural Resources) from Humboldt State University, USA, and a Doctorate in Range Science from Utah State University, USA.

**DR JAMES HORNE PSM**

Deputy Secretary

**Department of the Environment, Water, Heritage and the Arts**



Dr Horne is the Deputy Secretary responsible for the Water Group in the Australian Department of the Environment, Water, Heritage and the Arts. He chairs the inter-jurisdictional COAG Water Reform Committee and the Basin Officials Committee, the officials' body overseeing governmental water matters in the Murray–Darling Basin.

Between August 2000 and May 2005 he was First Assistant Secretary, Industry, Infrastructure and Environment Division, in the Department of the Prime Minister and Cabinet, with responsibility for advising the Prime Minister on a wide range of microeconomic policy issues. He played a central role in developing the 2004 National Water Initiative. Dr Horne worked in the Australian Treasury for 15 years from 1985 to 2000, where he held a number of senior executive positions, including General Manager, Macroeconomic Policy Division.

Dr Horne holds a PhD from the Australian National University and in 2002 he completed the Advanced Management Program at the Harvard Business School. He was awarded a Public Service Medal (PSM) as part of the Australia Day 2010 Honours for his outstanding public service in the area of water policy, use and management in Australia.

**PROFESSOR GARY JONES**

CEO

**eWater Cooperative Research Centre**



Professor Gary Jones is the Chief Executive of eWater Cooperative Research Centre (CRC) and of eWater Limited. He was formerly Chief Executive of the CRC for Freshwater Ecology (a forerunner of eWater CRC), 2002–05, having joined the CRC in 2001 as its Director of Knowledge Exchange. Previously he was a Senior Principal Research Scientist with CSIRO Land & Water.

Professor Jones has extensive experience of issues in environment and water management. He was previously a Board member of the Murray–Darling Freshwater Research Centre (2002–04), a member of the CSIRO Water for a Healthy Country National Advisory Council (2004–05), a member of the Australian State of the Environment Committee (2006), and Chair of the ACT Chief Minister's Water Supply Catchment Management Advisory Group (2005–06). He is currently a Director of both the Peter Cullen Water and Environment Trust and eWater Innovation Pty Ltd. In 2009 he was a member of the Prime Minister's Science, Engineering & Innovation Council Thematic Cluster: Climate Change, Energy, Water and the Environment.

He is an author on over 100 scientific papers, technical reports, book chapters and articles, on topics ranging from the chemistry, ecology and management of toxic cyanobacteria, to flow management in working rivers, and the management of the knowledge generated by scientific research organisations.

**PROFESSOR JURG KELLER**  
Director, Advanced Water Management Centre  
**University of Queensland**



Professor Keller is Director of the Advanced Water Management Centre at the University of Queensland and Professor in the School of Engineering. He has also an Australian Professorial Fellowship from ARC (Australian Research Council).

Professor Keller has close to 20 years' experience in water industry research, particularly in biological wastewater treatment, environmental biotechnology, microbial fuel cells and water recycling. While working at the leading edge of research and development, he has also several collaborative and consulting projects with industry partners, with total research projects underway to a value of around US\$20 million. He has been the founding Director of the AWMC since 1996 and has developed it into one of the leading research centres in this field worldwide, with more than 100 staff and students investigating innovative ways to improve water management.

**ASSOCIATE PROFESSOR GREG LESLIE**  
Deputy Director  
**UNESCO Centre for Membrane Science and Technology**



Professor Leslie is the deputy director of the UNESCO Centre for Membrane Science and Technology at the University of New South Wales. Prior to joining UNSW, he worked in the public and private sector on water treatment, re-use and desalination projects in Australia, New Zealand, Singapore, Hong Kong and the United States.

He currently serves on the National Health and Medical Research Council's Water Advisory Committee, the Independent Advisory Panel for the Orange County Groundwater Replenishment Project and was a past member of the World Health Organization Technical Committee preparing guidelines for desalination.

**MR KEN MATTHEWS AO**  
Chair and Chief Executive Office  
**National Water Commission**



Mr Matthews is Chair and Chief Executive Officer of the National Water Commission.

He has an economics degree from the University of Sydney, and is a Fellow of the Institute of Public Administration and the Australian Institute of Management.

He received a Centenary Medal for services to public administration in 2001, and was appointed Officer of the Order of Australia in 2005.

Mr Matthews has held the positions of Secretary of the Department of Transport and Regional Services and of the Department of Agriculture, Fisheries and Forestry.

**MS KARLENE MAYWALD**  
Director  
**Maywald Consultants PM Ltd**



Ms Maywald has extensive experience in the world of water politics. Her political career began in 1997 when she was elected to the seat of Chaffey as the sole National Party Member in the South Australian Parliament. She held this position until March 2010.

She was appointed Minister for the River Murray in August 2004 and Minister for Water Security in February 2007, at the height of the worst drought in recorded history. Ms Maywald is most noted for her significant contribution to progressing national reforms to the management of the Murray–Darling Basin and setting the direction for long-term water security in South Australia. She was also appointed Minister for Small Business, Regional Development, Consumer Affairs, Science and Information Economy, and Assisting the Minister for Industry and Trade, at different times during the nearly six years she was a Minister.

Ms Maywald is currently a Director of Maywald Consultants Pty Ltd, specialising in the area of water policy and advisory services.

**MR JAMES MCCOLL**  
Research Fellow  
**CSIRO Sustainable Ecosystems**



Mr McColl has considerable experience in public and private sectors, and in academia, in a wide range of positions and areas of responsibility.

He is a past Chairman and Managing Director of McColl Partners Pty Ltd, an agricultural and resource management consulting company based in Melbourne, Victoria, and a Senior Lecturer in Farm Management Economics, University of Melbourne.

In 1976, he was appointed as Director of Agriculture and Fisheries in South Australia and subsequently Director-General of Agriculture until resigning in 1985 and joining the Industries Commission (now Productivity Commission) as a full-time Commissioner.

He has served as Chairman, Australian Fisheries Management Authority (1992 to 2000), and as Presiding Member, South Australian River Murray Catchment Water Management Board (1998 to 2001). He joined CSIRO in 2001 as a Visiting Fellow, CSIRO Land and Water with research interests in water management and policy and structural adjustment. Currently, he is Research Fellow (part-time), CSIRO Sustainable Ecosystems, Policy and Economic Research Unit.

Mr McColl graduated with B.Agr.Sc. in 1956, and with M.Agr.Sc. in Agricultural Economics in 1973, both from the University of Melbourne. He is a Fellow of the Australian Institute of Agricultural Science and Technology, and a Distinguished Fellow of the Australian Agricultural and Resource Economics Society. In 2005, he received the Eureka Prize for Water Research jointly with Mike Young, and in 2006, was awarded a Centenary Medal for Agriculture, University Of Melbourne.

**COMMISSIONER ROBYN MCLEOD**  
Commissioner for Water Security  
**South Australian Government**



Ms McLeod is South Australia's first Independent Commissioner for Water Security.

She is responsible for leading the development of innovative policy solutions across Government to ensure the long-term future of South Australia's water supplies to meet the State's economic, environmental and social needs.

Her first priority has been to successfully develop and launch Water for Good, a plan to ensure South Australia's water future to 2050. Water for Good provides 94 actions to diversify South Australia's water sources, improve water conservation and efficiency, and modernise the water industry.

With an extensive background in water management and public policy for the past 20 years, Ms McLeod has a wealth of experience and knowledge in water issues throughout Australia and overseas and the challenges we face in the future to secure water availability.

**MR BRAD MOGGRIDGE**  
Indigenous Water Project Officer  
**CSIRO Water for Healthy Country Flagship**



Mr Moggridge is a Murri man from the Kamilaroi Nation (North-West NSW).

He was recently employed by CSIRO Land and Water as the Indigenous Water Research Projects Officer, to research Indigenous values of water (surface and groundwater) and traditional knowledge. He has been recently appointed to the First Peoples' Water Engagement Council administered by the National Water Commission.

He is currently researching topics on:

- effects of change in water availability on Indigenous people of the Murray–Darling Basin;
- Indigenous People and Groundwater; and
- Cultural Values and Water.

Prior to CSIRO Mr Moggridge spent 2008 working in a private environmental consultancy, where he gained significant exposure to the private sector. He has experience in environmental protection and regulation, which includes six years with the NSW Department of Environment, Climate Change and Water (DECCW), where he initiated and developed a series of environmental resources handbooks and DVDs for NSW Aboriginal communities.

He also spent four years in NSW local government, particularly in the arena of pollution control, water quality monitoring, on-site sewage management and urban salinity.

**PROFESSOR CHRIS MORAN**  
Director  
**Sustainable Minerals Institute**



Professor Moran started with a degree in agriculture and a PhD in soil science and digital image processing and worked as a natural resource scientist doing spatial science in CSIRO, for 16 years. He has been involved in minerals industry water and sustainability research for six years. He has published around 80 articles in scientific journals, technical reports and a significant number of commercial and government information papers and popular media reports.

His vision for the Sustainable Minerals Institute is to realise its potential to provide disciplinary excellence and creative ideas to support the global minerals industry achieve sustainable operations which will be indicated and accounted by the positive legacies they produce.

**MS BLAIR NANCARROW**  
Principal  
**Syme & Nancarrow Water**



Ms Blair Nancarrow spent 21 years as a social scientist at CSIRO Land & Water. She recently retired from CSIRO to take up work in her own consultancy and to work as a Visiting Fellow at the Fenner School of Environment and Society at the Australian National University in Canberra.

Her particular area of expertise has been in the design and implementation of community-based research programs and experiments in the people/environment interface. She has a special interest in the development of methods and processes to ensure the meaningful incorporation of social science in triple-bottom-line analysis of environmental policy and developments. As such, she is on a number of policy and research advisory committees nationally.

In her quest to integrate social science with the more technical sciences, Ms Nancarrow was recently awarded a Biennial Medal for services to the Modelling and Simulation Society in Australia and New Zealand.

**DR JOHN NUTT AM FTSE**  
Vice-President  
**Australian Academy of Technological Sciences and Engineering**



Dr Nutt has been a consulting engineer in Australia and UK since 1960, retiring in 2002. He was Chairman and CEO of Ove Arup and Partners in Australasia, helping to found the practice in 1963, and overseeing its development for 25 years.

He was Global Chairman of The Arup Partnerships, the organisation for coordination and strategy planning of all Arup practices throughout the world, and a Director in London, New York and Hong Kong. Prior to consulting he lectured at the University of Queensland and the Victoria University of Manchester, England.

**PROFESSOR MARY O'KANE FTSE  
NSW Chief Scientist and Scientific Engineer**



With a distinguished career spanning science, academia, engineering, policy development and business, Professor O'Kane brings well-rounded and high-level skills and experience to the position.

Professor O'Kane is a former Vice-Chancellor of the University of Adelaide. She has also served on a range of high level committees including the Australian Research Council and the CSIRO Board.

Professor O'Kane was chair of the recent Review of the Co-operative Research Centres Program, and a member of the panel for the Federal Government's recent Review of the National Innovation System. She also chairs two Cooperative Research Centres – the CRC for Spatial Information and the Australasian CRC for Interaction Design.

Professor O'Kane is also a businessperson who runs a consultancy advising governments, universities and the private sector on innovation, research, education and development.

**DR TONY PRIESTLEY  
Honorary Fellow  
CSIRO Land & Water**



Dr Priestley is a chemical engineer with more than 35 years experience in urban water research. His early research career involved the development of a number of innovative water treatment processes including SIROFLOCTM and magnetic ion exchange. For 13 years he was the Deputy CEO of the CRC for Water Quality & Treatment involving all aspects of water supply and recycling.

Since 2008, he has continued his research interests in resource recovery from wastewaters and the sustainability of urban water systems. He retired from CSIRO at the end of March 2010, but has returned as an Honorary Fellow to further pursue this research.

**MR DANIEL SPILLER  
Senior Director – Regional Planning & Policy  
Queensland Water Commission**



Mr Spiller has been at the Commission since 2006. He is the principal author of the South East Queensland Water Strategy. He leads the Regional Planning and Policy stream, which is responsible for Commission research and policy. He is also a Board member of the Urban Water Security Research Alliance, and has recently been the acting Executive Director of the Commission.

Mr Spiller previously worked at Brisbane City Council and the Office of Urban Management on land use and infrastructure planning matters, with a focus on water. He also has experience in economic regulation from his time at the Queensland Competition Authority, working on water and local government issues. He holds postgraduate qualifications in urban planning, economics, and applied finance and investment.

**MR DAVID TANNER FTSE**  
Engineering Manager – Process & Mechanical  
**Austrian Energy and Environment**



Mr Tanner is a graduate of Sydney University with extensive experience in the Energy Industry, and has worked for companies such as Babcock Energy (UK), BHP Engineering, ALSTOM, and currently AE&E Australia – a Sydney-based power plant EPC Contractor. He has been the lead engineer for many industrial and utility plant projects both in Australia and South East Asia, and has experience in the provision of the associated plant water supply systems including that for the 150MW Redbank Power Project, drawing water from the Hunter River under licence, and discharging treated effluent river according to the Hunter River Salinity Trading Scheme.

Current trends in the industry are towards minimising water use by recycling and treatment processes, and recent projects include a number with dry cooling systems due to limited water availability.

He is an ATSE NSW Committee member and has previously organised industry seminars on the subject of Emissions Trading (2008) and Energy Security (2009).

**MR MICHAEL TAYLOR AO FTSE**  
Chairman  
**Murray–Darling Basin Authority**



Mr Taylor is the Chair of the Murray–Darling Basin Authority. He took up his appointment as the Chair in May 2009.

Previously he was the Secretary of the Department of Infrastructure, Transport, Regional Services and Local Government (2004–09). Prior to that he was the Secretary of the Department of Agriculture, Fisheries and Forestry (2000–04) and Secretary for various Victorian Government Departments – the Department of Natural Resources and Environment (1996–00), the Department of Agriculture, Energy and Minerals (1995–96) and the Department of Agriculture (1992–95).

He has a long association with rural and regional issues. He has been extensively involved in preparing and negotiating international, Commonwealth and State agreements and legislation, and in advising Governments and Commonwealth/State Ministerial Councils on a wide range of agricultural, food, forestry, fisheries, energy, minerals, regional, water, environmental and sustainable natural resource management, policy, regulatory and operational issues.

In recent years, Mr Taylor has played a national leadership role in improving Quarantine Policy arrangements to increase Australia's protection from pests and diseases, the development of the National Food Industry Strategy, the establishment and implementation of the National Action Plan for Dryland Salinity and Water Quality, and the National Water Initiative.

His academic background is in agricultural science and economics. He completed a Bachelor of Agricultural Science at the University of Melbourne in 1970 and a Diploma in Agricultural Economics at the University of New England in 1972.

**DR JOHN WILLIAMS**  
Commissioner  
**NSW Natural Resources Commission**



Dr Williams is one of Australia's most respected natural resource scientists. He has contributed constructively to the national debate on sustainable land and water management.

Prior to joining the Natural Resources Commission in NSW in 2006, he was appointed Chief Scientist and Chair of the NSW Department of Natural Resources' Science and Information Board, following his retirement as CSIRO's Chief of Land and Water in 2004. He was awarded the prestigious Farrer Memorial Medal for achievement and excellence in agricultural science in 2005 and continues as Adjunct Professor in Agriculture and Natural Resource Management at Charles Sturt University.

Dr Williams is a founding member of the Wentworth Group of Concerned Scientists and has extensive experience in providing national and international thought leadership in land and water management. He continues to engage at the important interface between science and public policy particularly in agriculture production and its environmental impact.

**SENATOR THE HON. PENNY WONG**  
**Minister for Climate Change, Energy Efficiency and Water**

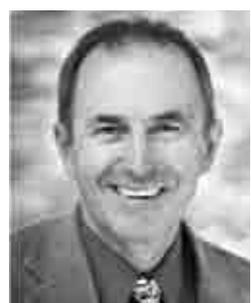


Senator Wong was born in Malaysia and moved to Australia when she was eight. Before entering Parliament, she was a barrister and solicitor in Adelaide and worked as an adviser to the Carr Government in New South Wales.

She was elected as a Labor Senator for South Australia in November 2001 and began her term in July 2002. In December 2007 Senator Wong was appointed to Cabinet in the Labor Government as the Minister for Climate Change and Water, and in March 2010 the Prime Minister added the Energy Efficiency portfolio to her responsibilities.

Senator Wong has been a strong promoter of women's issues in the ALP, leading the successful charge for rule changes on affirmative action at a state and national level.

**PROFESSOR MIKE YOUNG FASSA**  
Executive Director – Environment Institute  
**University Of Adelaide**



Professor Young is Executive Director of the University of Adelaide's Environment Institute, holds a Research Chair in Water Economics and Management at the University of Adelaide, is a Fellow of the Academy of Social Sciences in Australia and is a Distinguished Fellow of the Australian Agricultural and Resource Economics Society.

A Member of the Wentworth Group of Concerned Scientists, in 2006, he was awarded the Land and Water Australia Eureka Award for Water Research. The award recognised the significant contribution of his research with Jim McColl to the introduction of improved water entitlement, water allocation systems and trading systems.

Professor Young is best known for his capacity to integrate biophysical and economic information to produce innovative policy proposals that catalyse change. He holds Adjunct Professorships with the University of New England and Charles Sturt University. Prior to joining the University of Adelaide, he spent 30 years with CSIRO where he established its Policy and Economic Research Unit with offices in Adelaide, Canberra and Perth.

In 2003, he was awarded a Centenary Medal “for outstanding service through environmental economics”. In 2005, the *Canberra Times* recognised him as “Green Australian of the Year”. In 2006, the *Canberra Times* listed him as one of the 10 most influential people in water policy reform. Most recently he was named South Australian of the Year in the Environment Category.

# Organising Committee

The Organising Committee comprise the ATSE Leadership Group for the Water Forum, plus National Water Commissioner, Mr Chris Davis

**DR JOHN RADCLIFFE AM FTSE (Chair)**  
 Honorary Research Fellow  
**CSIRO**



Dr Radcliffe is an Honorary Research Fellow in CSIRO, a member of the Council of the University of Adelaide, Chair of the Department of Agriculture, Fisheries and Forestry Eminent Scientists Group and was a Commissioner of the National Water Commission from 2005 to 2008. He is Chair of the Academy's Water Forum. In 2004, he authored the Academy's publication *Water Recycling in Australia*.

Prior to formal retirement in 1999, Dr Radcliffe was a Deputy Chief Executive of CSIRO. Previously, he had been the last South Australian Director-General of Agriculture. He has an agricultural science degree from the University of Adelaide, a PhD from Oregon State University and a Graduate Diploma from the Australian Institute of Company Directors. He was awarded the Medal of the Order of Australia in 1987 for his contribution to museum development, and an AM in 2001 for natural resource management.

**DR TOM CONNOR AO FTSE**  
 Vice President Technology  
**Kellogg Brown & Root**

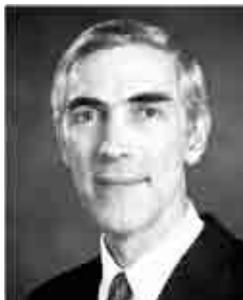


Dr Connor is Vice President Technology for the global Infrastructure & Minerals (I&M) business unit of Kellogg Brown and Root (KBR). Responsibilities cover their TechEx program, Sustainability, Knowledge Management and its aid projects. He has been involved with water, coastal engineering and sedimentation projects in Australia and internationally for more than 30 years with the firm in Australia (previously Kinhill) and internationally, including, since 2000, a series of major projects in Viet Nam.

He is a Past National President of Engineers Australia (1996–97) and received the Order of Australia (AO) award for his services to water engineering in 1999. He has also been the recipient of the Queensland Engineer of the Year Award, the Centenary Medal and the Peter Nicol Russell Memorial Medal by Engineers Australia. He is an Honorary Fellow of Engineers Australia.

At the State level, he is a Director of SunWater (2003 to date) and Chair of the Queensland Sustainable Energy Innovation Advisory Council (from 2000 to date).

**DR BRIAN SPIES FTSE**  
Formerly Science Manager  
**Sydney Catchment Authority**



Dr Spies has 40 years' experience in research and management roles in the resource and environmental sectors in Australia and the US. Most recently, he was Principal Scientist, Sustainability and Climate Change at the Sydney Catchment Authority (SCA), where he worked on impacts, adaptation and organisational resilience under climate change.

Prior to joining the SCA, he was a Chief Research Scientist with CSIRO Exploration and Mining where he worked on an inter-agency review of salinity mapping technologies and risk analysis. Prior appointments include director of the physics division at the Australian Nuclear Science and Technology Organisation (ANSTO) and director of the Cooperative Research Centre for Australian Mineral Exploration Technologies.

Dr Spies has served on the NSW Committee of ATSE and in a number of ATSE workshops and forums. He chaired the Participants Forum of the eWater CRC and served on the Board of the CRC for Freshwater Ecology and Australian Institute of Nuclear Science and Engineering.

He holds a BSc from the University of NSW and a PhD from Macquarie University. His US experience includes research posts at Arco Oil and Gas Company and Schlumberger-Doll Research, where he pioneered imaging methods for non-destructive testing of oil pipelines and for characterising and monitoring deep petroleum reservoirs.

He is an active promoter of the science and profession of geoscience and has held numerous editorial and honorary positions. He was elected a fellow of the ATSE in 1998, and has served as president of the Australian Society of Exploration Geophysicists and 1st Vice President of the 20,000-member Society of Exploration Geophysicists, and was awarded the Australian Centenary Medal for his services to Australian geosciences.

**MR CHRIS DAVIS**  
Commissioner  
**National Water Commission**



Mr Davis has spent 37 years working in the water industry, mainly focusing on the urban sector. He is an adjunct Professor in the Faculty of Engineering and Information Technology at the University of Technology, Sydney, where his substantive position is as Sustainability Business Development Manager.

Apart from his roles with the Water Commission and UTS, he chairs the Urban Water Security Research Alliance in South-East Queensland and the Independent Review Panel for the Sydney Metro Water Plan. He also serves on the NHMRC Water Quality Advisory Committee, which has been revising the Australian Drinking Water Guidelines. As well as working in the technical and research areas of water, Mr Davis served for 15 years as CEO of the Australian Water Association (AWA) and is a Life Member of that association, as well as the American Water Works Association.

He has written two editions of *Water in Australia: Facts & Figures, Myths & Ideas* and edited a manual, *Watershed Management for Drinking Water Quality*.

# ATSE Water Forum Reference Group

**DR PETER CRAWFORD AM FTSE**  
Formerly Managing Director  
**Sydney Water**



Over 30 years Dr Crawford focused on strategic leadership, effective management and institutional change in the public and private sector organisations he led and advised. He was responsible for development of public policy and reform for the NSW, South Australian and Commonwealth governments and at the OECD in Paris. He served as Chief Executive of the NSW State Pollution Control Authority, Sydney Water, (where he led that organisation through transformational change) and the South Australian Departments of State Development and Premier and Cabinet (where he helped to rebuild the economy and public sector, post recession).

Dr Crawford has edited and written many reports and books on environmental and water management, including a series of reports during eight years as NSW Healthy Rivers Commissioner. His recent books, *The Serious Business of Governing* and *Captive of the System*, deal with direction-setting and institutional reform in government. From 1994 to 2006 he was a Visiting Professor at Macquarie and Newcastle universities, NSW.

**DR RICHARD DAVIS**  
Senior Science Advisor  
**National Water Commission**



Dr Davis has had an extensive career in water and environmental research with CSIRO, Australia, specialising in environmental flows, water quality, catchment management and decision support systems. He has also worked for Australian government policy departments, the World Bank, and Land and Water Australia. He is currently Senior Science Advisor to the Australian National Water Commission.

**PROFESSOR MIKE MANTON FTSE**  
Chair  
**ATSE International Strategy Group**



Professor Manton was Chief of the Bureau of Meteorology Research Centre from 1984 until his retirement in 2006 and he now has a part-time position as Professor in the School of Mathematical Sciences at Monash University.

For 12 years he was a member of the Joint Scientific Committee for the World Climate Research Programme (WCRP) and for nine years he was chair of the Atmospheric Observation Panel (AOPC) of the Global Climate Observing System (GCOS). From 2002–06 he was chair of the National Committee for Earth System Science of the Australian Academy of Science.

His initial training was in mechanical engineering and his PhD is in oceanography from the University of British Columbia. For five years he lectured in Mathematics at Monash University in the early 1970s, and he was then a research scientist in CSIRO Division of Cloud Physics for 10 years. His research has been in turbulence, sea waves, boundary layer flows, cloud physics and climate.

Professor Manton is a member of the Board of ATSE, and is chair of the ATSE International Strategy Group. He is currently the ATSE observer on the National Committee for Earth System Science (NCESS).

**MR BRIAN SADLER PSM FTSE**  
Principal Partner  
**Water Policy Services**



Mr Sadler is an engineer/hydrologist with 49 years' experience in water resources management, planning and policy at State and national levels. Internationally he has contributed in public participation, planning and the role of water in society. He has been active on climate change adaptation since the late 1980s and Chair of the Indian Ocean Climate Initiative Panel from 1998 until 2006. After 40 years with the State of Western Australia, concluding as Executive Director of Water Resources, he is now an independent consultant and active ATSE Fellow.

His professional base is in engineering hydrology broadened into water resources assessment, water planning and water resources and salinity management across Mediterranean, sub-tropical and semi-arid climate zones of Australia's western third. This included long range planning for integrated regional and conjunctive use water systems, regional salinity strategies and resource allocation.

In the 1980s, for Perth's system, he initiated the first Australian water planning response adapting to risks of anthropogenic climate change. He subsequently led Perth's water system planning into publicly developed risk management embracing demand side and supply side components.

Within his State career Mr Sadler had prominent roles in several national water assessments. He chaired several learned society and State/Commonwealth committees relating to water planning and hydrology and championed development of public involvement and triple-bottom-line planning processes in Western Australia. As independent Chair of the Indian Ocean Climate Initiative he was an active advocate of informed risk management for living and adapting in a changing climate.

Mr Sadler was a foundation director of the International Association of Public Participation; Chair of a UNESCO panel on the role of water in society; Australia's water expert in the Middle East peace process and a contributor to UN related water activities from Scandinavia to South America, the US and the Middle East. He has published numerous papers, articles and reports on water planning, public consultation and adaptation to climatic risk.

### MR ROSS YOUNG

Executive Director

#### **Water Services Association of Australia**



Mr Young commenced as the Executive Director of the Water Services Association of Australia (WSAA) in 2004. WSAA is the peak body for the urban water industry and its members provide water services to 16 million Australians (80 per cent of the population).

He has extensive experience in urban water management at a senior level having held a number of key executive positions with Melbourne Water for over a decade. Whilst at WSAA he has raised the profile of the Australian urban water industry, represents the Australian urban water industry on water policy at the national level and regularly contributes to debates on urban water issues.

Mr Young is the Chair of the Global Water Research Coalition Board and a Board Member of WaterAid Australia. He has a Diploma of Horticultural Science, a Bachelor of Applied Science, an MBA and a Graduate Diploma in Natural Resources Law from the University of Melbourne.

# Invited Participants

**MR BARRY BALL PSM**  
Deputy Director  
**Global Change Institute**



Mr Ball is the Deputy Director of the newly established Global Change Institute at the University of Queensland. He is also the Manager Water Policy at the International Water Centre. He has worked in both State and Local Government in his 35-year career. His most recent roles were the Manager Strategic Planning and Manager Water Resources in Brisbane City Council.

Some of his achievements include the establishment of the Moreton Bay Waterways and Catchment Partnership, adoption as formal Council policy by Brisbane an integrated “whole of water” strategy and establishment of a whole of region Water Quality Monitoring Program.

Mr Ball is a registered professional Engineer and has recently been awarded the Australian Public Service Medal for his achievements in water policy. He is on the Urban Water Advisory Committee for the National Water Commission and has held Board positions on the CRC Catchment Hydrology, CRC Coastal Zone, International River Foundation and Environment Professional Board at Griffith University.

**DR C. IAN CHESSELL FTSE**  
**Chief Scientist – South Australia**



Dr Chessell was appointed Chief Scientist of South Australia in March 2008. After completing a PhD in physics at Melbourne University in 1970, Dr Chessell followed a career in the Defence Science and Technology Organisation, retiring as Australia’s Chief Defence Scientist in 2003. Dr Chessell served as a member of the Prime Minister’s Science, Engineering and Innovation Council (2001–03) and in 2003 he was awarded the Centenary Medal for services to defence science. Dr Chessell was elected a Fellow of the Australian Academy of Technological Sciences and Engineering in 2003.

Dr Chessell was appointed the Chairman of QinetiQ Pty Ltd in 2008. He is a member of the Board of the Anglo-Australian Telescope. Dr Chessell is a member of the Defence South Australia Advisory Board and of the South Australia Renewable Energy Advisory Board. He was the Chair of the independent Technology Advisory Council of Tenix Pty Ltd for 2004–07.

Dr Chessell chaired the Commonwealth Government’s reviews of National ICT Australia in 2005 and of the Anglo-Australian Telescope in 2006. He was a member of the Commonwealth Government’s Review of the CSIRO’s Flagship Program in 2006.

**MS ERIN CINI**  
Director  
**Element Solutions Pty Ltd**



Ms Cini is a Director of Element Solutions Pty Ltd; a consultancy dedicated to water and sustainability planning and project management. She is an environmental engineer with a water project delivery background and a passion for sustainability. As one of many of us in the water industry who are responsible for literally planning and building Australia's future, she is excited about the opportunities we have to make good decisions now to ensure we build our sustainable future.

Ms Cini is actively involved in the Australian Water Association and is the founder of the infra:LINK program, which brings together emerging leaders in infrastructure committed to the inclusion of sustainability in infrastructure decisions and projects.

**DR WENDY CRAIK AM FTSE**  
Commissioner  
**Productivity Commission**



Dr Craik was appointed a full-time Commissioner of the Productivity Commission in June 2009 and is currently working on the Wheat Export Market Arrangements inquiry. She was Chief Executive of the Murray–Darling Basin Commission from 2004–08. Prior to this she had a variety of positions including President of the National Competition Council, Chair of the National Rural Advisory Council, Executive Director of the National Farmers Federation and Executive Officer of the Great Barrier Reef Marine Park Authority.

Dr Craik is on several boards and was awarded the Member of the Order of Australia in 2007 for service to the natural resource sector of the economy, particularly in the areas of fisheries, marine ecology and management of water reform, and for contributions to policies affecting rural and regional Australia.

**DR JANE DOOLAN**  
Executive Director – Sustainable Water, Environment and Innovation  
**Department of Sustainability & Environment**



Dr Doolan is Executive Director of Sustainable Water Environment and Innovation at the Office of Water (Department of Sustainability and Environment), in Victoria. She has spent the past 20 years working in the field of waterway management, as an exponent of Australian river health, driving key policy in issues of environmental water allocations and river-related catchment management.

Dr Doolan has led a number of pivotal developments in river health management, including the establishment of Victoria's Catchment Management Authorities, and the creation of the Victorian River Health Strategy (2002), the first state framework for integrated management of rivers within a catchment context. She also led the development of environmental watering policy for the Victorian Government's long-term water security plan, Our Water Our Future (2004). She is the Victorian representative on the Murray–Darling Basin Natural Resource Management Committee and National Water Commission committees. Among her other responsibilities, she currently oversees Victoria's implementation of the environmental delivery component of The Living Murray program, and is a board member of eWater Ltd (the Cooperative Research Centre).

DR IAN J DUNCAN FTSE

Chair

**WA Division, ATSE**



Dr Duncan's career was with Western Mining Corporation, joining in 1971 as Operations Manager, Exploration Division. He retired as General Manager of the large Olympic Dam copper, uranium, gold and silver operation in South Australia.

Due to his involvement in uranium exploration, production and marketing over 25 years, he became aware of the world's nuclear fuel cycle and nuclear power technology. He was Chairman of the London based Uranium Institute (now World's Nuclear Association) 1995–96. Since retirement he completed a doctorate at the University of Oxford which addressed "the interface between society and the disposal of radioactive waste". He is Chairman of Energy Ventures Ltd, a junior uranium exploration company.

DR THERESE FLAPPER

Director

**iConneXX**



Dr Flapper has more than 20 years' experience in water, wastewater and recycled water management, including process optimisation and design, water quality monitoring, audit, institutional innovation and research commercialisation. She maintains a focus on business and environmentally sustainable projects. Her skills have been applied across municipal and industrial wastewater management from onsite to large-scale systems. She has also had a significant role in directing and managing research programs in the water sector, resulting in commercialisation of new technology and services.

Dr Flapper holds competencies in ISO22000, ISO9001, ISO14001 and is a Lead Auditor (NSCI Certification) as well as being an approved National and International Technical Reviewer for the Australian Water Association (AWA), International Water Association (IWA) and American Water Works Association (AWWA). She was past State President (NSW) and Federal Board Member of the AWA, and is currently Deputy Chair Australian Committee of the IWA.

MR ALAN GREGORY

Research Theme Leader – Urban Water

**CSIRO Water for a Healthy Country Flagship**



Mr Gregory leads the Urban Water Research Theme at CSIRO, one of four research themes under the Water for a Healthy Country National Research Flagship. The aim of the program is to provide underpinning science to enable Australian cities to transition to more sustainable water management practices and involves more than 100 CSIRO researchers and a range of collaborative partners.

He has more than 30 years' management and technical experience across most aspects of water management including strategic planning, demand management, water recycling, systems planning and design, network operations, regulation and pricing, and customer services. Prior to joining CSIRO in 2005, he led the development, implementation and governance of Sydney Water's water efficiency and water recycling strategies, the largest integrated demand management program in Australia. Over a five-year period this program achieved a 30GL per year reduction in demand.

**PROFESSOR GUSTAAF HALLEGRAEFF FTSE**  
Professor – Institute for Marine and Antarctic Studies  
**University of Tasmania**



Professor Hallegraeff was educated at the University of Amsterdam as a limnologist, before joining in 1978 the CSIRO Marine Laboratories in Sydney and later Hobart, and ultimately in 1992 the School of Plant Science and now Institute of Marine and Antarctic Studies of the University of Tasmania.

He is recognised nationally and internationally for his work on harmful algal blooms impacting on human health, the fish farm and shellfish industries, their stimulation by coastal eutrophication and global spreading via ship's ballast water. His current research focus is on the impact of climate change on phytoplankton in Australian coastal waters and the Southern Ocean, including an interest in the problem of algal biotoxins in desalinated drinking water. He was awarded the 2004 Eureka Prize for Environmental Research, and currently is the Vice-President of the International Society for the Study of Harmful Algae.

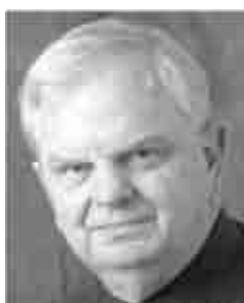
**DR WILL HOWARD**  
Assistant Director  
**Office of the Chief Scientist**



Dr Howard is a research scientist currently at the Office of the Chief Scientist in Canberra, on leave from the Antarctic Climate and Ecosystems CRC in Hobart, Tasmania. He works on marine climate change, with particular emphasis on ocean acidification and its impacts on the past, current, and future ocean. He is particularly interested in the ocean carbon cycle and the responses of marine ecosystems to climate change. His work focuses on the insights into climate change that can be inferred from ocean sediment records as a baseline for pre-industrial conditions and as a tool for understanding the impacts of large-magnitude climate changes of the scale anticipated in the coming centuries. His expertise is in palaeoecology and low-temperature isotopic geochemistry.

Dr Howard has a PhD in Geological Sciences from Brown University in Providence, Rhode Island, was a US Department of Energy Global Change Distinguished Postdoctoral Fellow, at Lamont-Doherty Earth Observatory of Columbia University (1992–93), and was a lecturer in oceanography at the Sea Education Association (1994–95) before joining the Antarctic CRC in Hobart in 1996.

**MR RICHARD KELL AM FTSE**  
Director  
**Cardno International Pty Ltd**



A Civil Engineer, Mr Kell has spent his working life as a consulting engineer and project manager in infrastructure engineering, as an engineer, Managing Director and Chairman of significant Australian/International engineering consultant Cardno Pty Ltd (listed on ASX), previously McMillan Britton and Kell. He is now a consultant and director of Cardno International Pty Ltd.

He has been involved in civil engineering, planning, design and management, of water and wastewater, bridge, road and marine projects, throughout Australia and in PNG, Malaysia, Abu Dhabi, Indonesia, Solomon Islands and Vietnam, and continues as

project director on overseas projects for his firm. President 2003–05 of the International Federation of Consulting Engineers, FIDIC. He is a Fellow and Chair of NSW Division of ATSE.

Mr Kell was made a Member of the Order of Australia (AM), 1998, for services to Engineering, particularly Bridge Engineering and International Affairs. He is an Honorary Fellow of the Institution of Engineers, Australia, and recipient, 2000, of IEAust John Connell Medal for Structural Engineering. He was awarded an Australian Centenary Medal in 2003.

**MR MARK PASCOE**  
CEO

**International Water Centre**



Mr Pascoe has worked for more than 30 years in the water industry, predominantly in Brisbane, Australia. His professional background is in Applied Science and Environmental Engineering. He spent many years with Brisbane City Council (BCC), where he was most recently the Manager, Water and Sewerage. Other roles in BCC included Manager of Water Treatment and Manager of Wastewater Treatment. For a brief period in the mid 1990s he worked for the environmental consultancy firm, Woodward-Clyde. He left the BCC role to take up a position as Deputy Director, International Water Association in London, which he held for three years before returning to Brisbane early in 2005.

Mr Pascoe is now CEO of the International Water Centre Pty Ltd where his role is to lead the development of the joint venture in providing solutions to water management issues for national and international clients, particularly in the areas of education, training and applied research, with a vision of developing our future water leaders. Previously he has held positions of President, Australian Water Association; Board Member, Water Services Association of Australia; Board Member, CRC for Water Quality and Treatment; Member of Panel for development of the Australian Drinking Water Guidelines; Board Member, Global Water Research Coalition; Board Member of Healthy Waterways Ltd, Board Member of the Advanced Wastewater Management Centre, University of Queensland (UQ), and Advisory Board Member, UNEP International Environment Technology Centre, Osaka, Japan; Board Member, Environment Business Australia and Board Member of Queensland Manufactured Water Authority and the associated Australian Water Recycling Centre of Excellence. He is also an Adjunct Professor with UQ's Faculty of Engineering, Architecture and Information Technology.

**MR JOHN RUPRECHT**  
Executive Director – Agricultural Resource Risk Management  
**Department of Agriculture and Food**



Mr Ruprecht has a Bachelor of Engineering (Civil), Masters in Engineering Studies and also in Business Administration. He has more than 25 years' experience in water supply, water resource management, and natural resource management. He also has extensive experience in water resource management across Western Australia related to flood management, salinity management, urban water, water availability and water resource assessment.

Mr Ruprecht is currently Executive Director, Agricultural Resource Risk Management in the Department of Agriculture and Food, WA. He is also a past chair of the National Committee of Water Engineering for Engineers Australia and a past president of the WA Division – Engineers Australia.

**MR ANDREW SPEERS**  
National Manager – Policy  
**Australian Water Association**



Mr Speers is National Manager, Policy, with the Australian Water Association, responsible for policy development and advocacy on behalf of the Association and its members. He has 25 years experience in the water and environment fields.

Previously, he was Director, Member Services and Programs with the International Water Association (IWA) based in London. In this role, he was responsible for negotiating the Bonn Charter for Safe Drinking Water and developing the IWA's sustainability framework. Before joining IWA, he was Director, Urban Water, with CSIRO. The Urban Water Program sought means by which water, wastewater and stormwater services could be made more sustainable and provided research services to industry and government in Australia and internationally. Mr Speers has also been engaged as Manager, Environment with Sydney Water and as a Senior Policy Advisor to the NSW Minister for the Environment, during which time he project managed a series of significant environmental law reforms.

**MR MARTIN THOMAS AM FTSE**  
Chair  
**Dulhunty Power Ltd**



Mr Thomas has had a lifetime career in energy consulting, concluding as a Principal of Sinclair Knight Merz. Later he was founding Managing Director of the CRC for Renewable Energy, ACRE. Former roles include Deputy Chairmanship of Australian Inland Energy, Chairmanship of Alecto Energy Plc; non-executive Directorships of the Tyree Group and EnviroMission; and Advisor to the Board of ZBB Energy. He has also served as Chairman of industry association Austenergy, the NSW Electricity Council and the Sydney 2000 Olympic Energy Panel.

He is currently Chairman of Dulhunty Power Ltd (ASX:DUL) and the Asia Pacific International College (APIC). He is a past President of the Institution of Engineers, Australia and of the Australian Institute of Energy and a past Vice-President of ATSE of which he now chairs the Energy Forum. In 2008 he was awarded the Peter Nicol Russell Memorial Medal, the highest award of Engineers Australia.

In 2006 Mr Thomas served as a member of the then Prime Minister Howard's Uranium Mining, Processing and Nuclear Energy Review taskforce known as UMPNER.

**MR TOM VANDERBYL**  
Manager – Strategy and Stakeholder Relations  
**SunWater Limited**



Over the past two decades, Mr Vanderbyl has been instrumental in the development, trialling and application of water management, planning and institutional policies, processes and approaches in Queensland.

His present role as SunWater's Manager of Strategy & Stakeholder Relations encompasses responsibility for managing SunWater's relationship with government, customers and other stakeholders. He is responsible for leading SunWater's corporate planning and risk management functions in liaison with

the CEO, senior management and the Board. He oversees SunWater's water portfolio with respect to pricing, policy, planning and regulatory obligations associated with SunWater's 23 Resource Operating Licences.

Mr Vanderbyl is committed to working closely with the water industry to identify and adopt water management innovations that will assist in enhancing productivity and profitability of SunWater customers. He is a member of the Board of Irrigation Australia Limited and the National Water Accounting Standards Board and is involved in the Australian Water Resource Information System (AWRIS) Steering Committee and National Program for Sustainable Irrigation (NPSI) Program Management Committee.

**MR CLIVE WEEKS FTSE**  
Executive Consultant  
**GHD Pty Ltd**



Mr Weeks retired from staff-owned engineering / environmental Consultants GHD Pty Ltd after 38 years service last year. His last six years were as CEO and then Executive Chairman during which time GHD's turnover and staff numbers increased by more than three times to \$1billion and more than 6500 staff. He continues as a part time Executive Consultant with GHD, mainly involved at a high level on major infrastructure projects.

His main interests are water resources and water related infrastructure projects and management.

Mr Weeks became an ATSE Fellow in 2008 and is now a member of the Victorian ATSE Committee. He is on the Monash University Engineering Foundation Board and is Chairman of the Rotary Club of Melbourne Community Foundation. He is a Fellow of the Institution of Engineers Australia, Fellow of the Australian Institute of Company Directors and a Member of the Australian Water Association.





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## Water and Its Interdependencies in the Australian Economy – International Workshop Report

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