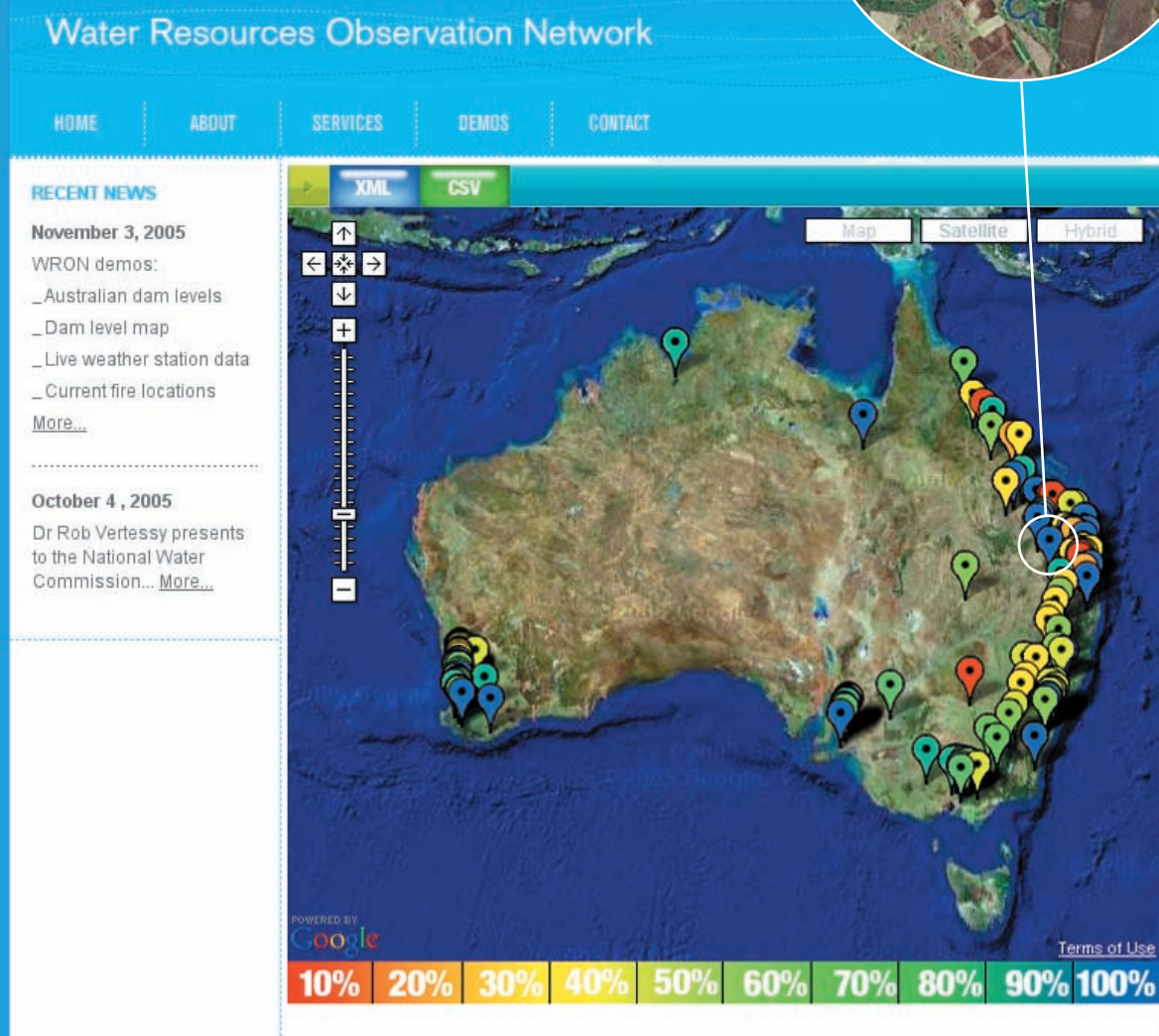


Building a Water Resources Observation Network

In Australia, we're now facing some of the biggest environmental challenges to date, and water scarcity is right at the top of the list. But we are still to tackle the tough decisions about its competing uses. **Clare Peddie** reports on the emergence of the Water Resources Observation Network, a new development that promises to transform national water resource management through harnessing high technology.



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The Water Resources Observation Network (WRON) website features demonstrations of the intended web-based water management and information applications. www.wron.net.au

In 2000, Mikhail Gorbachev and Shimon Peres, both past recipients of the Nobel Peace Prize, named water the key issue of the 21st century. 'As population grows, economies develop and megacities expand, greater and greater demand will be placed on freshwater supplies,' they wrote. 'This condition can either be a motor for peace, leading to unprecedented cooperation to manage supplies, or it can generate greater conflict, perhaps even war in water-scarce regions.'

Even before the turn of the century, tensions were rising in Australia. Battles were breaking out between irrigators, regulators, scientists and environmentalists over water rights. But that, according to CSIRO Land and Water Research Director Dr Stuart Minchin, was only the beginning.

'I believe we're going to see a lot of court activity around water resource entitlements in the future,' he says. 'We've given water rights the same status under law as land title – in broad terms – but we can't accurately measure the edges. You know, "this is my water, and

But water is a commodity unlike any other. It's difficult to measure. It can be used more than once. And, as Gorbachev and Peres pointed out, unlike a resource such as oil, water has no substitute.

that's your water''', he continues. 'And there's nothing like a court case to make you challenge your standards of evidence.'

Much of the information we currently have about our nation's water resources simply wouldn't stand up in court. Until recently, it didn't have to.

'For a while we've been able to just add users; we kept expanding the resource and the environment took all the risk,' Minchin explains. 'Everyone still got their entitlement, but sometimes the environmental water dried up.'

'There are also commercial imperatives. Temporary and permanent trades are increasing; knowing where the water resource is, who is using it and what opportunities there are for trade is part of the modern water business,' Minchin says.

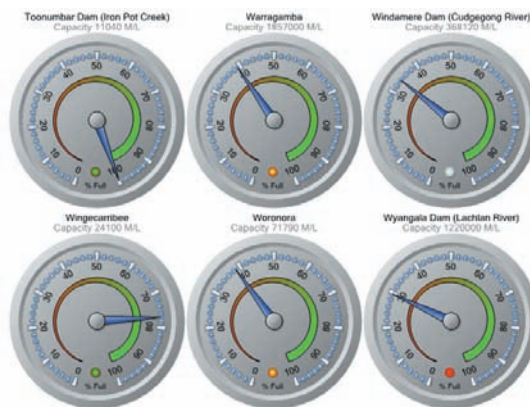
'You can't just keep exploiting the resource. It's a zero sum game.'

But water is a commodity unlike any other. It's difficult to measure. It can be used more than once. And, as Gorbachev and Peres pointed out, unlike a resource such as oil (for which coal, wind or nuclear power can be an alternative), water has no substitute.

Using technology to our advantage

Keeping track of the water we have now (and can expect to have in the future), as well as who is entitled to use it, and under what conditions, is a massive, daunting task. At the moment, relevant data is collected and archived by more than a hundred separate agencies. It's captured in so many different ways, and kept in so many different places, that it is almost impossible to make any sense of it.

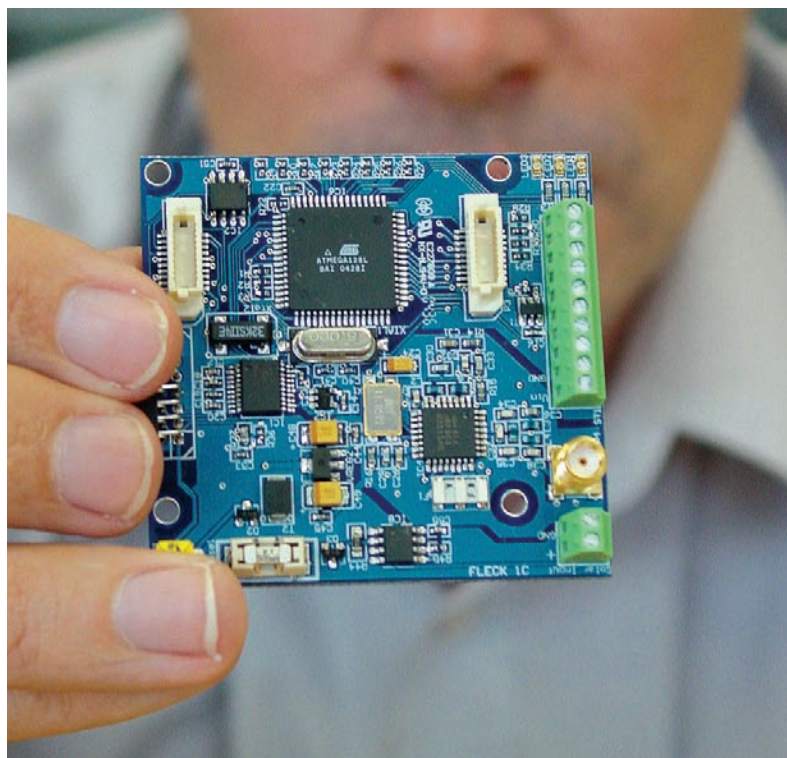
Some researchers believe the answer to this problem will come from the information and communication



The WRON demonstration web-application showing real-time water levels across key dams, nationally.
www.wron.net.au

technology (ICT) sector. People can now do remarkable things with wireless sensors, satellites, mobile phones, computers and the internet – and these tools already have much to offer in tracking and enabling efficient water resource use.

It appears that the time has come for a revolution in water resource management. Using technology, relevant information can be drawn into one comprehensive 'national water account', available to all. This is the timely objective of Water Resources Observation Network (WRON) being planned for Australia. Web-based reporting tools can be delivered to suit the individual needs of various end-users, and raw data, forecasts and predictions processed by sophisticated computer models can be employed to support and justify informed management decisions.



Potential applications in environmental monitoring, including waterways and oceans: The CSIRO-developed FLECK module is a low-cost embedded sensing and computing device with ad hoc wireless capability. It consists of a low-power central processing unit with additional off-chip flash memory and a radio receiver. Each FLECK has circuitry to charge a battery from a solar cell, and sensors for battery, solar and temperature levels built directly into the base platform as standard. CSIRO ICT Centre



The Water Resources Operations Centre (WROC), operated by the Korean Water Corporation (South Korea) in Daegu, monitors water resources across the country, managing floods, water allocation and hydropower generation. Most of the hydrometric data network in South Korea is monitored remotely in real-time via a pervasive wireless network, supplemented by satellite-based communications (shown on screen).

Courtesy of KOWACO

An exchange with South Korea

Like Australia, South Korea is grappling with a serious water crisis, owing to population growth, per capita increases in water consumption, climate change and pollution of the water resource base. And the South Koreans are aiming the best available technology at the problem.

Chief of CSIRO Land and Water, Dr Rob Vertessy, has made five visits to South Korea since 1998, and there have been reciprocal visits to Australia by South Koreans from various universities and private firms. In October 2004 Dr Vertessy led an Australian Water Resources Science and Technology Mission to South Korea, supported by the Department of Education Science and Training's International Science Linkages (ISL) Programme.

'South Korea has exceptional skills in water engineering and ICT, and is using these to good effect,' Dr Vertessy says. 'For instance, almost all of the hydrometric data network in South Korea is monitored remotely in real-time via a pervasive wireless network, supplemented by satellite-based communication networks. Australia is years behind them in this area,' he observes.

'A tremendous example of South Korean innovation in this domain can be found at the Water Resources Operations Centre (WROC) operated by the Korean Water Corporation (South Korea) in Daegu,' Dr Vertessy continues. 'This state-of-the-art facility is used to monitor water resources across the country and manage floods, allocations of water to consumptive uses, and to optimise hydropower generation. The WROC is part control centre and part education facility, and sets a compelling example for the Australian water industry to follow.'

In return, South Korean scientists are keen to explore our expertise in catchment modelling, ecosystem understanding and water-related public policy.

The Australian WRON is being scoped under the auspices of the Water for a Healthy Country National Research Flagship, with input from at least three divisions of CSIRO and a growing alliance of research partners. The first step in the evolution of the WRON is setting data standards – and establishing agreements on how data will be shared, considering both security and access. Other challenges, being addressed by

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CSIRO's Mathematical and Information Science's Division, include the selection of monitoring units, network design, real time analysis, handling large data sets and the integration of information from electronic and conventional sources.

A common language for water

The problem of access to and the integration of different dispersed data sets has been recognised for some time now, especially in the geospatial communities. Finding and gaining access to these data using a common interface (or single point of entry) has been the first step toward data integration. The Australian Spatial Data Directory (ASDD), launched back in 1998, illustrated this first phase. Beyond ASDD, the next generation of information systems will expose not only data but processing services as well (such as interfaces to hydrological models), allowing web applications to automatically access online data, services and even real-time information.

Water data sets can already be found online, if you know where to look, but there's another problem: before we can put all the pieces together, we need to understand what we're looking at. We need standards – and we need a way of showing that 'this measurement was taken, using this standard'. The WRON is aiming to achieve this too.



CSIRO scientist Dr Sue Vink collects samples for water quality research from the Murrumbidgee River near Gundagai, NSW. The WRON may be the start of a nationwide system that ultimately reduces much local manual effort in water monitoring. CSIRO Land and Water

'It's like what happened to enable the World Wide Web,' explains Dr Minchin. 'HTML is the perfect example. Everyone said what we're going to do is create a language, where I can publish a page to the world and every browser knows how to read it.'

'Water needs the same level of standardisation. Only now we're talking about employing a Water Resources Mark-up Language – or WRML.'

Using WRML, database managers will be able to expose their data to the web in such a way that will

enable others to instantly recognise what the database contains and how to use it.

And that's the key. That is what drives Minchin, and others like him: being able to use this data – information about the resource (water quality, stream flow), entitlements, use, and so on – at a moment's notice, without having to 'clean' and prepare it for modelling. The WRON will provide a whole host of web services – via a powerful, accessible information platform.

'By linking data sets and models together we can basically build applications to tap into these new services,' says Ross Ackland from the CSIRO Information and Communication Technologies Centre. It's the next step in the evolution of the World Wide Web: beyond a collection of isolated web sites, to a place where data sets and models are exposed in a unified web services interface.

The potential for great advances in the way we acquire, store and analyse data is already being realised by other sectors of the scientific community. Struggling with the same kinds of problems, different groups are coming up with remarkably similar solutions – in health and statistics, as well as geospatial industries. 'It's no surprise. There's a real need,' Ackland observes.

An example is the CSIRO-initiated Health Data Integration project, now being applied by the e-Health Research Centre, which promises to provide private and secure access to medical records and other relevant information. Then there's the national data network (NDN) being developed by the Australian Bureau of Statistics, for access to all statistical data held in public databases nationally. CSIRO was involved in this one too.

Water as we've never seen it before

By 2010, it is hoped the WRON will underpin national water resource management in this country. It will acquire, store and interpret data and forecasts, providing real-time assessments and future projections of water availability, allocation and use across the nation.

The concept is well supported by an alliance that includes the Bureau of Rural Sciences, Bureau of Meteorology, Geosciences Australia, Australian Bureau of Agricultural and Resource Economics, Australian Bureau of Statistics, eWater Cooperative Research Centre, National Land & Water Resources Audit, Sinclair Knight Merz and the Murray-Darling Basin Commission – together with CSIRO.

Success will depend on the cooperation and support of state governments and catchment management authorities: the key 'end-users'. It is still early days, but the WRON vision is captivating and word is spreading. Right now, the alliance is gathering teams keen to help demonstrate the potential of a Water Resources Observation Network for Australia. Altogether, it's unprecedented cooperation in the effort to advance water management, just as Gorbachev and Peres hoped.

More information:
www.wron.net.au

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