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<td>Andrew Ross</td>
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<tr>
<td><strong>Water Links</strong></td>
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</table>
2010 marks the ANU Water Initiative’s fourth anniversary and what a tremendous four years it has been! In this, the 2009-2010 annual report, it is very clear that our efforts to increase the ANU’s strengths in water resources management, to develop our interdisciplinarity, and to expand our engagement within Australia and internationally, have paid off.

On the education front, the undergraduate water major has been a significant highlight and reflects the ANUWI commitment to encouraging an integrative and holistic approach to water resource management. Our enrolment figures demonstrate a keen interest from the next generation to understand Australia’s most important environmental challenge; over the last few years, approximately 25% of all postgraduates enrolled in ‘environment related’ higher research degrees were directly engaged in water science/resources/management research, in addition to the hundreds of undergraduates enrolled in the many water-related courses on offer across campus. With demand for environmental professionals increasing every year, it is reassuring to know that the ANU is providing our students with the necessary skills and experience to make a meaningful contribution to the nation’s workforce. Of course, with the regular ANUWI activities and events on offer, all of our ‘water’ students have access to colleagues in other schools and colleges from different disciplines, as well as having the opportunity to speak with key government and industry officials from the water sector.

The highlight for 2009-2010 is undoubtedly the UNESCO Chair in Water Economics and Transboundary Water Governance where the Chairholder will be Professor Quentin Grafton. Launched by the Hon. Bob McMullan in April, the aim of the UNESCO Chair is to promote sustainable development and better water management in Africa, and the ANU will be working with WaterNet, UNESCO-IHE, the Global Water Partnership, the International Water Management Institute as well as the University of Pretoria (South Africa), Wuhan University (China), the International Centre for Water Economics and Governance in Africa and the University of London to meet the program’s aims. As part of the UNESCO Chair, Daniel Connell will be Director of Education, and Jamie Pittock will be Director of International Programs.

No less significant was the ANUWI’s contribution to National Water Week, in October. Thanks to Jenna Roberts’ tireless efforts, the ANU convened an all-day ‘mini-conference’, with speakers from across the ANU, University of Canberra, Actew and CSIRO. Congratulations are in order for Fenner School PhD student Catherine Gross who was awarded the ‘ANUWI Outstanding Presenter’ prize! To cap the week off, Rod Quantock presented ‘Thirsty Work’ for the ANU-Toyota National Water Week Public Lecture – with much hilarity enjoyed by all.
Internationally, the ANUWI’s collaboration with the European organization “COST” (European Collaboration in Science and Technology), focusing on the energy-water nexus, has proved very successful, with a special issue of *Ecology and Society* due for publication in mid 2010. Featuring ten international case studies profiling various aspects of the energy-water nexus, the publication has already attracted significant attention and will be launched in both hemispheres – once in June in Oviedo, Spain by invitation of the Spanish Presidency of the European Union and again in Canberra in November.

These are just some of the highlights of our successes in 2009 and 2010 and we urge you to enjoy all the details in the remainder of this report. Before signing off for another year, we would like to extend our heartfelt thanks to Noel Chan, who continues to provide us with outstanding administrative support without which we could not function. Noel is expecting her first baby in July, and we wish her all the best in welcoming her little bundle into the world, and for her subsequent maternity leave. We will be thinking of you Noel!

Finally, we would like to remind you that the success of a cross-campus initiative like this relies on the input and feedback of all interested people on-campus, so, if you have something you would like to share with ANU’s ‘water’ community, please feel free to contact us directly, and, of course, make use of the ANUWI website and mailing list.

From the Chairs,

Karen Hussey & R. Quentin Grafton
About ANUWI

About Us

The ANU Water Initiative is a cross-disciplinary, university-wide initiative that brings together ANU researchers and educators in the water domain.

The ANU Water Initiative aims to:

- identify gaps in our understanding of the water system and provide solutions to the most important and urgent of questions for sustainable water management;
- develop a holistic approach to sustainable water management by building on, and integrating, our significant strengths across the colleges of water-related research and education;
- develop new approaches to research question formulation, collaborative teamwork, knowledge brokering and the creation of policy-relevant solutions in water; and
- engage with key stakeholders in the water domain.

Our Themes

The four core themes divide the whole into ‘conceptual regions’ that cover the most significant issues in an inherently integrative manner. Within the themes the issues are complex and require multi-sectoral and multidisciplinary approaches involving various stakeholders with different interests and policy agendas. The relationship between the research themes is similarly important for the integration of rural, peri-urban and urban water systems and management.
ANUWI Steering Committee

The ANU Water Initiative Steering Committee is a small, skills-based group of key ANU water-related researchers and educators from across the major disciplines. The Steering Committee is charged with providing leadership for the ANU Water Initiative on behalf of ANU as a whole; provide overall strategic direction of the Initiative; and to represent areas of research and/or academic areas for inclusion in the Initiative’s activities.

Karen Hussey    (Co-Chair)  Crawford School of Economics and Government, and Office of the Vice Chancellor
Quentin Grafton (Co-Chair)  Crawford School of Economics and Government
Daniel Connell   (Director, Education Programs, UNESCO Chair)  Crawford School of Economics and Government
Sara Beavis The Fenner School of Environment and Society
Jeff Bennett Crawford School of Economics and Government
Stephen Dovers Director, The Fenner School of Environment and Society
Mike Hutchinson The Fenner School of Environment and Society
Tony Jakeman The Fenner School of Environment and Society
Judy Jones ANU College of Law
D.C. “Bear” McPhail Research School of Earth Sciences
Barry Newell The Fenner School of Environment and Society
Paul Perkins The Fenner School of Environment and Society
John Reid Environment Studio, School of Art
Will Steffen Director, ANU Climate Change Institute
Andrew Walker Resource Management in Asia-Pacific Program (RMAP), Research School of Pacific and Asian Studies (RSPAS)
Ian White The Fenner School of Environment and Society
Roz Smith * ANU Climate Change Institute
Lance Heath * ANU Climate Change Institute

* Coordinating role for ANU Climate Change Institute and not a member of Steering Committee
ANU Water Expertise

Water-related education and research is currently carried out across the campus in a range of disciplines and academic areas. The work conducted and expertise within these areas is summarised below.

<table>
<thead>
<tr>
<th>Academic area</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANU College of Arts &amp; Social Sciences</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Faculty of Arts | • Creating contemporary music & visual aesthetic material addressing water  
| School of Art | • Critical re-enforcement of cultural foundations for addressing water challenges  
| School of Music | |
| Research School of the Humanities | • International water policy |
| Centre for Aboriginal Economic Policy Research | • Regional profiling of demographic & socioeconomic characteristics of Indigenous people, including basin & catchment level profiling  
| | • Investigating Indigenous peoples' economic, social & cultural interests in water |
| **ANU College of Asia & the Pacific** | |
| Crawford School of Economics and Government | • Economics & decision making  
| | • Water policy & regulation  
| | • Water pricing, markets & sales  
| | • Ground water access & management  
| | • Water supply & allocation  
| | • Climate adaptation  
| | • Hydro-economic modelling  
| | • Groundwater modelling |
| Research School of Pacific and Asian Studies | • Gender & water  
| | • Water & development  
| | • Water & communities  
| | • Social, economic & cultural aspects of water resource management  
| | • Water & environmental history  
| | • Water resource politics  
| | • Quality of water & spread of water-borne diseases  
| | • Water pricing issues  
| | • Attainment of water related MDG in Asia Pacific Region  
| | • Planning for the water needs of Asian mega-cities |
| **ANU College of Law** | |
| Faculty of Law | • Federalism & water regulation  
| | • History of water use, law & policy  
| | • Human rights & water  
| | • Indigenous rights & interests in water (onshore & offshore)  
| | • Property rights in water  
| | • Regulatory design for scientific uncertainty (precaution)  
| | • The law of international watercourses  
| | • Water policy & regulation |
| **ANU College of Medicine, Biology and Environment** | |
| National Centre for Epidemiology and Population Health | • Public health & water-borne diseases  
| | • Water & development  
| | • Cross-disciplinary integration for policy & practice |
| The Fenner School of Environment & Society [including Integrated Catchment Assessment and Management (iCAM)] | • Integrated water resources management  
| | • Water policy & regulation  
| | • Water quality  
| | • Sedimentation & salinity  
| | • Ground water & surface water  
| | • Decision support systems  
| | • Water trading  
| | • Institutional analysis  
| | • Indigenous water knowledge & cultural flows |
ANU College Physical Sciences

Research School of Earth Sciences
- Groundwater
- Water quality
- Geomorphology and regolith
- Geochronology
- Trace element & isotope analysis geochemistry
- Fluid dynamics
- Remote sensing and water resources
- Marine biogeochemistry

ANU Water Capacities

Researchers and educators at the ANU have established strengths across a broad spectrum of water-related issues, from global change, public health, policy analysis, environmental law, environmental economics, indigenous and gender issues, through to hydrology, geochemistry and membrane technology which are applied over a wide range of temporal and spatial scales. In 2009, ANUWI had over 100 staff/research students across different colleges and departments registered in the network.

Figure 3: Water expertise in ANU across disciplines
### ANUWI activities

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities</th>
</tr>
</thead>
</table>
| 2006 | ANU Water Initiative established  
National Water Conference, 4-5 December |
| 2007 | ‘Water Matters’ Colloquium, 24-25 August  
ANU NeWater Workshop on Adaptive Water Management, 28 August  
Water-related Undergraduate and Postgraduate Programme offered in ANU |
| 2008 | ANUWI Workshop on the Links Between Climate, Energy and Water, 6 March  
Seed Investment Funding Proposal on Freshwater Study  
Aspi Baria PhD Scholarship on Australian water research  
Capital-WATER established, 22 July  
ANU Drought – Past and Future Conference, 14-15 November |
| 2009 | ANU-COST Energy-Water Links Workshop, 19-21 January, Brussels (Workshop 1)  
IARU Climate Congress, 10-12 March, Copenhagen  
ANU-COST Energy-Water Links Workshop, 8-10 June, Brussels (Workshop 2)  
ANU has become a partner of Global Water Partnership (GWP)  
ANU National Water Week 2009, 21 October  
Skukuza 2009 Workshop, 7-11 September  
ANUWI Get Together 2009, 20 November  
ANU-COST Side Event and Launch of Special Issue of Journal, UNFCCC COP15, 10-17 December, Copenhagen |
| 2010 | Centre for Water Economics, Environment and Policy (CWEEP) established, 1 February  
Official Launch – UNESCO Chair in Water Economics and Transboundary Governance, 15 April  
The Australian Earth Sciences Convention, 4-8 July, Canberra |
| **On-going activities** | ANUWI website and e-list: for water information and research publication exchange |
Activities highlights in 2009

Seed Investment Funding Proposal on Freshwater Study

In keeping with the spirit of the Hilda John Bequest the ANU Water Initiative (ANWI) invites proposals from groups of ANU researchers on environmental issues related to fresh water in Australia. The intention is to provide seed investments for up to three research groups to develop a series of research proposals, activities, collaborations and outputs that would assist each of the groups to successfully compete for long-term research funding in fresh water research before the end of 2010. Potential sources of external funding include the Australian Research Council and similar funding bodies as well as philanthropic foundations. See ANUWI Projects for details.

Successful proposals

- National Centre for Groundwater Research and Training (Tony Jakeman)
- ANUWI Climate-Energy-Water Links (CEWL) Program (Barry Newell, Karen Hussey)
- Managing Climate Risk Project (Daniel Connell)

Global Water Partnership (GWP)

ANU has become a Partner of the Global Water Partnership (GWP) on 5 March 2009. GWP’s vision is for a water secure world. Its mission is to support the sustainable development and management of water resources at all levels. It was founded in 1996 by the World Bank, the United Nations Development Programme (UNDP), and the Swedish International Development Agency (former Integrated Water Resource Management (IWRM)), and to ensure the coordinated development and management of water, land, and related resources by maximizing economic and social welfare without compromising the sustainability of vital environmental systems.

GWP Partner Certificate
Skukuza 2009 Workshop
7-11 September, Goolwa, South Australia

The Skukuza 2009 workshop, co-sponsored by the ANU Water Initiative, has issued this summary communiqué on the key conclusions reached by the scientists who gathered at Goolwa South Australia. A special edition of Marine and Freshwater Research is due to be published in 2010 based on the workshop’s papers and deliberations. Media cover for the workshop can be found in the ABC News. See ANUWI Projects for detailed report.

ANUWI Get Together 2009
20 November, ANU

To help our water communities connect with what we are all doing and connect to each other, the ANUWI Steering Committee has agreed to fund an end-of-year social event. There were more than 40 members attended the gathering. The event has provided an opportunity for ANU water researchers and students to network, engage and share research ideas and insights.
In response to the National Water Week on 18-24 October 2009, the ANUWI supported the College of Physical Sciences and Research School of Earth Sciences presents the ‘National Water Week ANU Seminar Day’. The theme of the seminar is “Securing Our Water Future”.

The seminar day has invited ANU academics and PhD students from all fields to give a short presentation about their latest research on water-related topics, e.g., arts, economics, law, policy, science, culture, psychology and social sciences. There are also guest speakers from Actew, CSIRO and University of Canberra. This has been an excellent showcase of ANU’s strong contribution to worldwide water issues, and an opportunity to celebrate achievements, make new contacts within ANU and externally, and plan for the future. See ANUWI Projects for detailed report.

### Seminar Day Presentation schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Presenter(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 – 9:20</td>
<td>Quentin Grafton, ANU Water Initiative</td>
<td>Opening Address</td>
</tr>
<tr>
<td>9:20 – 10:00</td>
<td>ACTEW CORPORATION</td>
<td>Ian Carmody, Director: Water Security Operations, Actew Corporation</td>
</tr>
<tr>
<td>10:00 – 11:00</td>
<td>iCAM, Fenner School of Environment and Society</td>
<td>‘Integrated assessment and decision support for water resources management’</td>
</tr>
<tr>
<td>10:00 – 10:20</td>
<td>Carmel Pollino, Wendy Merritt, Jennifer Ticehurst, Baihua Fu, Rebecca Kelly</td>
<td>‘Supporting effective management of water-dependent ecosystems: the role of DSS and integrative models’</td>
</tr>
<tr>
<td>10:40 – 11:00</td>
<td>Barry Croke, Natasha Herron, Chris Thompson, Felix Andrews</td>
<td>‘Biophysical models: development and testing techniques’</td>
</tr>
<tr>
<td>11:30 – 12:50</td>
<td>‘From Groundwater to Atmosphere’</td>
<td>SESSION 1</td>
</tr>
<tr>
<td>11:50 – 12:10</td>
<td>Julia Jasonsmit, RSES</td>
<td>‘There’s salt in the Wybong Creek catchment – but where is it from?’</td>
</tr>
<tr>
<td>12:10 – 12:30</td>
<td>Warren Hicks, CSIRO</td>
<td>‘Gas emissions from the wetland soils of a salinised semi-arid river floodplain’</td>
</tr>
<tr>
<td>12:30 – 12:50</td>
<td>Wee-Ho Lim, RSB</td>
<td>‘The aerodynamics of pan evaporation’</td>
</tr>
<tr>
<td>13:40 – 15:40</td>
<td>‘Governance, policy, social reform and risk analysis’</td>
<td>SESSION 2</td>
</tr>
<tr>
<td>13:40 – 14:00</td>
<td>Kate Harriden, Fenner School of Environment and Society</td>
<td>Water diaries: exploring household flows’</td>
</tr>
<tr>
<td>14:00 – 14:20</td>
<td>Katherine Daniel, Centre for Policy Innovation ANU</td>
<td>‘Water governance and participatory risk management approaches: insights from the field’</td>
</tr>
<tr>
<td>14:20 – 15:00</td>
<td>Daniel Connell, Crawford School of Economics &amp; Government</td>
<td>‘Murray Darling Basin Water Politics and Governance’</td>
</tr>
<tr>
<td>14:40 – 15:00</td>
<td>Qiang Jiang, Crawford School of Economics &amp; Government</td>
<td>‘Costs and benefits of the Australian water buyback’</td>
</tr>
<tr>
<td>15:00 – 15:20</td>
<td>Leo Carroll, Fenner School of Environment and Society</td>
<td>‘Australian water reform: where do social objectives come into it?’</td>
</tr>
<tr>
<td>15:40 – 16:00</td>
<td>Catherine Gross, Fenner School of Environment and Society</td>
<td>Trade-off in drought: Perceptions of need and injustice in water distribution in Australia</td>
</tr>
<tr>
<td>16:00 – 16:20</td>
<td>Fiona Dyer, eWater, University of Canberra</td>
<td>‘Water supplies for the future: predicting ecological responses for decision making’</td>
</tr>
<tr>
<td>16:20 – 17:20</td>
<td>‘Secure water versus insecure fish: potential impacts of the expanded Cotter Reservoir on the endangered Macquarie Perch’</td>
<td>SPECIAL FEATURE PRESENTATION: eWater CRC, University of Canberra</td>
</tr>
<tr>
<td>16:20 – 17:20</td>
<td>‘Using underwater video to monitor artificial habitat use by freshwater fish’</td>
<td>SPECIAL FEATURE PRESENTATION: eWater CRC, University of Canberra</td>
</tr>
<tr>
<td>17:00 – 17:20</td>
<td>Jason Theim</td>
<td>‘Monitoring Macquarie Perch use of constructed homes in Cotter Reservoir using remote telemetry’</td>
</tr>
</tbody>
</table>

Remarks: The event was made possible thanks to the initiative and passion of Jenna Roberts, the winner of the ANUWI Aspi Baria PhD Scholarship.
Formal launch: Centre for Water Economics, Environment and Policy (CWEEP)

1 February 2010, Crawford School, ANU

The Centre for Water Economics, Environment and Policy (CWEEP) was launched by Dr James Horne (Deputy Secretary, Department of the Environment, Water, Heritage and the Arts) at University House on Monday 1 February. The launch coincided with a Water Markets workshop, funded by the Murray-Darling Basin Authority and facilitated by the Crawford School of Economics and Government at the Australian National University. The Water Markets workshop was a one-day interactive workshop on current and future Water Markets issues in the Murray-Darling Basin. See P.44-45 for more details on CWEEP.
Official Launch: UNESCO Chair in Water Economics and Transboundary Water Governance
15 April 2010, Crawford School, ANU

The UNESCO Chair in Water Economics and Transboundary Water Governance was officially launched by the Hon. Bob McMullan MP, the Australian Parliamentary Secretary for International Development on 15 April 2010. It was followed by brief addresses from Professor Lawrence Cram, Deputy Vice-Chancellor of the ANU, and Professor Tom Kompas, Director of the Crawford School of Economics and Government at the ANU. The UNESCO Chair in ANU has been established to promote the Millennium Development Goals of environmental sustainability in Africa of the UN. Over the next four years the UNESCO Chair will work with its network partners in Southern Africa and collaborators in China to promote water research, training, capacity building and knowledge transfer.

The nominated Chairholder is Professor Quentin Grafton of the Australian National University. Dr Daniel Connell is Director of Education Programs and Jamie Pittock is Director of International Programs of the UNESCO Chair (as of August 2010). Details see P.48-50.
ANU Water Programs and Courses

1) ANU undergraduate water degrees

The ANUWI has developed majors in water science and policy in the Bachelor of Science (BSc) and the Bachelor of Interdisciplinary Studies (Sustainability (BIS). These majors are designed to offer students courses that focus their learning on water science, policy, management, engineering and the socio-cultural facets related to water. The major reflects the ANUWI’s commitment to an integrative approach to water resource management as espoused in the Strategic Plan. The water majors have been offered by the ANU since 2007/2008. The Fenner School of Environment and Society and the Research School of Earth Sciences in the Colleges of Science offer several degrees with a specific environment and sustainability focus.

<table>
<thead>
<tr>
<th>Water-related Program</th>
<th>Academic Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Interdisciplinary Studies (Sustainability) – Water Science and Policy Major</td>
<td>Professor Peter Kanowski</td>
</tr>
<tr>
<td>Bachelor of Interdisciplinary Studies (Honours) (Sustainability) – Water Science and Policy Major</td>
<td>Dr Bear McPhail and Prof Tony Jackman</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) - Water Science and Policy Major</td>
<td>Dr Bear McPhail and Prof Tony Jackman</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) - Water Science and Policy Double Major</td>
<td>Dr Bear McPhail and Prof Tony Jackman</td>
</tr>
<tr>
<td>Bachelor of Arts / Bachelor of Science (BSc) (combined degree) - Water Science and Policy Major</td>
<td>Dr Bear McPhail and Prof Tony Jackman</td>
</tr>
<tr>
<td>Bachelor of Arts / Bachelor of Science (BSc) (combined degree) - Water Science and Policy Major</td>
<td>Dr Bear McPhail and Prof Tony Jackman</td>
</tr>
<tr>
<td>Bachelor of Global and Ocean Sciences (Honours)</td>
<td>Dr Michael Roderick</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental / partial water-related Program</th>
<th>Academic Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Science (BSc) – Earth and Environmental Science Major</td>
<td>Dr Bear McPhail and Dr John Field</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) – Environmental Geoscience Major</td>
<td>Dr Bear McPhail</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) – Environmental Modelling Major</td>
<td>Prof Tony Jackman</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) – Environmental Policy Major</td>
<td>Prof Steve Dovers and Dr Richard Bakers</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) – Natural Resource Management Major</td>
<td>Dr John Field</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) – Sustainability Science Major</td>
<td>Prof Peter Kanowski</td>
</tr>
<tr>
<td>Bachelor of Science (Resource and Environmental Management) (single and combined degrees)</td>
<td><a href="mailto:Science.Enquiries@anu.edu.au">Science.Enquiries@anu.edu.au</a></td>
</tr>
<tr>
<td>Bachelor of Science (Resource and Environmental Management) / Bachelor of Laws</td>
<td><a href="mailto:Science.Enquiries@anu.edu.au">Science.Enquiries@anu.edu.au</a></td>
</tr>
<tr>
<td>Bachelor of Arts / Bachelor of Sciences (combined degree) – Environmental Policy Major</td>
<td>Prof Steve Dovers and Dr Richard Bakers</td>
</tr>
<tr>
<td>Bachelor of Arts / Bachelor of Sciences (combined degree) – Environmental Studies Major</td>
<td>Dr Robert Dyball</td>
</tr>
<tr>
<td>Bachelor of Arts / Bachelor of Sciences (combined degree) – Geography Major</td>
<td>Dr Bruce Doran</td>
</tr>
<tr>
<td>Bachelor of Commerce – Corporate Sustainability Major</td>
<td><a href="mailto:info.cbe@anu.edu.au">info.cbe@anu.edu.au</a></td>
</tr>
</tbody>
</table>
Water Science & Policy Major or Double Major
Academic Contacts: Dr Bear McPhail and Prof Tony Jakeman

Water is emerging as a critical issue for societies and the environment in Australia, in our region, and in many other parts of the world. The major and double major in Water Science and Policy provides students with the opportunity to develop knowledge central to the understanding and management of water resources, and to develop expertise and undertake research relevant to one of four theme areas associated with water: earth and environmental sciences; environmental modelling; environmental policy; and water chemistry and quality. It is intended that students selected courses from one or two of the four themes areas, which draw on the University substantial research activities.

Courses offered towards the Water Science & Policy Major or Double Major are (core courses in bold):

- CHEM1101 Chemistry I
- CHEM2204 Environmental Chemistry
- EMSC1006 The Blue Planet
- EMSC2014 Surficial Processes
- **EMSC3025 Groundwater**
- EMSC3023 Global Cycles II: The Modern Oceans
- EMSC3027 Global Cycles and Palaeoceanography
- EMSC3028 Coastal Environmental Earth Science
- EMSC3050 Special Topics
- ENVS1001 Resources Environment and Society
- **ENVS1004 Australia’s Environment**
- ENVS2004 Weather, Climate & Fire
- **ENVS2007 Economics for the Environment**
- **ENVS2008 Hydrology for Natural Resource Management**
- **ENVS3005 Water Resource Management**
- ENVS3010 Independent Research Project
- ENVS3004 Land and Catchment Management
- ENVS3013 Climatology
- ENVS3028 Environmental Policy and Planning
- ENVS3031 MDB Field School
- ENVS3018 Policy and Institutional Analysis for Sustainability
- **ENVS3034 Water Quality and Environmental Flow Assessment**
- MATH1014/1116 Mathematics and Applications
- MATH2305/2405 Differential Equations
- **MATH3133 Environmental Modelling and Integrated Assessment**
- SCOM2001 Science Communication

Water and environmental-related undergraduate courses

ANU also offered a wide range of environment-related courses for undergraduate studies and most of them cover water-related areas as part of the course. In 2009 and 2010, there were 103 and 101 undergraduates enrolled in water dedicated water courses just in the Fenner School alone. If one includes all the other courses at the ANU with substantial water components, there are hundreds of undergraduates enrolled in water-related courses annually. A select list of environmental-related courses are listed below (courses highlighted in blue and bolded are dedicated ‘water’ subjects).

Undergraduate environmental-related courses offered in ANU

**ANU College of Arts and Social Sciences**

School of Archaeology & Anthropology

- ANTH1002 Culture and Human Diversity
- ARCH2041 Introduction to Environmental Archaeology
- **BIAN2119 Nutrition, Disease and the Human Environment**
- **BIAN3119 Regional Topics in Nutrition, Disease and the Human Environment**

School of Philosophy

- PHIL2114 Sustainability, System and Agency
- **HIST2129 Country Lives: Australian Rural History**

School of Sociology

- SOCY2022 Environment and Society
- SOCY2035 Development and Change of Urban Society
- **SOSY2030 Sociology of Third World Development**
- POPS2001 Population and Society
- SOCY2032 Population and Australia
- **ARTV1100 Introduction to the Creative Digital Environment**
- **ARTV2022 Complementary Studies 2**
- **ARTV2023 Complementary Studies 3**
- **ARTV2100 Complementary Studies 3**
- **ARTV3024 Complementary Studies 4 (Environmental Studio)**
<table>
<thead>
<tr>
<th>School of Economics</th>
<th>School of Management, Marketing &amp; International Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>POPS4005F Population Studies IV (H)</td>
<td>MGMT2001 Corporate Sustainability</td>
</tr>
<tr>
<td>POPS4005P Population Studies IV (H)</td>
<td>MKTG2002 Sustainable Marketing</td>
</tr>
<tr>
<td>ECON2129 Resource and Environmental</td>
<td>BUSN3017 Corporate Social Responsibility</td>
</tr>
<tr>
<td>Economics (H)</td>
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</tr>
<tr>
<td>ECON2128 Resource and Environmental</td>
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<tr>
<td>Economics (P)</td>
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**ANU College of Engineering and Computer Science**

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<thead>
<tr>
<th>School of Engineering</th>
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<tbody>
<tr>
<td>ENGN1215 Engineering Sciences</td>
<td>ENGN2225 Systems Engineering Design</td>
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**ANU College of Law**

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<tbody>
<tr>
<td>LAWS2215 Environmental Law</td>
<td>LAWS2253 International Environmental Law</td>
</tr>
<tr>
<td>LAWS2216 Environmental Law Elective</td>
<td>LAWS2274 Climate Law</td>
</tr>
<tr>
<td>LAWS2224 International Law Elective: Law</td>
<td>LAWS3103 Law and the Environment</td>
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**ANU Colleges of Science**

**Fenner School of Environment and Society**

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<tbody>
<tr>
<td>ENVS1001 Resources, Environment and</td>
<td>ENVS3013 Climatology</td>
</tr>
<tr>
<td>Society: Geography of Sustainability</td>
<td></td>
</tr>
<tr>
<td>ENVS1104 Australia’s Environment</td>
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<tr>
<td><strong>ENVS2008 Hydrology for Natural Resource</strong></td>
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<tr>
<td>Management</td>
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<tr>
<td>**ENVS2009 Ecological Measurement and</td>
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<tr>
<td>Modelling</td>
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<tr>
<td>**ENVS2024 Weather, Climate and Fire</td>
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<tr>
<td><strong>ENVS2007 Economics for the Environment</strong></td>
<td></td>
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<tr>
<td>**ENVS2011 Human Ecology</td>
<td></td>
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<tr>
<td>**ENVS2012 Cities and their Hinterlands</td>
<td></td>
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<tr>
<td>**ENVS2013 Environment and Development</td>
<td></td>
</tr>
<tr>
<td>**ENVS2001 Climate Change Field School</td>
<td></td>
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<tr>
<td><strong>ENVS3004 Land and Catchment Management</strong></td>
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<tr>
<td>**ENVS3005 Water Resource Management</td>
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<tr>
<td>**ENVS3007 Participatory Resource</td>
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<td>Management</td>
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**Research School of Chemistry**

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<tbody>
<tr>
<td>CHEM2204 Environmental Chemistry</td>
<td>BIOL2112 Marine Biology</td>
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<tr>
<td>CHEM3040 Ecochemistry</td>
<td>BIOL3153 Conservation Biology</td>
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**Research School of Earth Science**

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<tbody>
<tr>
<td>EMSC1006 The Blue Planet</td>
<td>EMSC3023 Global Cycles II: The Modern Oceans</td>
</tr>
<tr>
<td>EMSC2014 Surficial Processes, Source to</td>
<td>EMSC3025 Groundwater</td>
</tr>
<tr>
<td>Sink</td>
<td>EMSC3027 Global Cycles and Palaeoceanography</td>
</tr>
<tr>
<td>EMSC2015 Chemistry of the Earth</td>
<td>EMSC3028 Coastal Env Earth Science</td>
</tr>
<tr>
<td>EMSC2016 Resources and Environment</td>
<td>EMSC3029 Ocean and Atmosphere Modelling</td>
</tr>
<tr>
<td>EMSC2019 Marine Palaeontology and the</td>
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<tr>
<td>Evolution of Life on Earth</td>
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<tr>
<td>EMSC3019 Coral Reef Studies</td>
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**Department of Nuclear Physics**

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<tbody>
<tr>
<td>PHYS3034 Physics of Fluid Flows</td>
<td>MATH3133 Environmental Mathematics</td>
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</table>
2) ANU postgraduate water courses

Over the last few years, approximately 25% of all postgraduates enrolled in ‘environment related’ higher research degrees were directly engaged in water science/resources/management research. Postgraduate students can also specialize in water-related topics from the different Graduate Certificate, Graduate Diplomas and Master degrees programs on offer across campus.

### ANU Postgraduate study with environmental / water-related theme

<table>
<thead>
<tr>
<th>Graduate Research Area (PhD and/or MPhil)</th>
<th>Academic Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropology</td>
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<tr>
<td>Ecology Evolution and Systematics</td>
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<tr>
<td>Engineering and Information Sciences</td>
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<tr>
<td>Environment and Resource Management</td>
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<tr>
<td>Economics</td>
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<tr>
<td>Epidemiology, Population Health and Health Services</td>
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<tr>
<td>Geographical Sciences</td>
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<tr>
<td>Geosciences</td>
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<tr>
<td>Interdisciplinary Cross-Cultural Research</td>
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<tr>
<td>Law</td>
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<table>
<thead>
<tr>
<th>Graduate Certificate by coursework</th>
<th>Academic Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate Certificate in Environment</td>
<td>ANU Colleges of Science</td>
</tr>
<tr>
<td>Graduate Certificate in Environmental Law</td>
<td>Faculty of Law</td>
</tr>
<tr>
<td>Graduate Certificate in Environmental Management and Development</td>
<td>Crawford School of Economics and Government</td>
</tr>
<tr>
<td>Graduate Certificate in Environmental Science</td>
<td>ANU Colleges of Science</td>
</tr>
<tr>
<td>Graduate Certificate in Geographical Sciences</td>
<td>ANU College of Medicine, Biology &amp; Environment</td>
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</table>

<table>
<thead>
<tr>
<th>Graduate Diplomas by coursework</th>
<th>Academic Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate Diploma in Environment, specializing in</td>
<td>ANU Colleges of Science</td>
</tr>
<tr>
<td>Integrated Assessment Modelling</td>
<td>Dr Barry Croke and Prof Tony Jakeman</td>
</tr>
<tr>
<td>Water Science and Management</td>
<td>Prof Tony Jakeman and Dr Lachlan Newman</td>
</tr>
<tr>
<td>Global Change</td>
<td>Dr Janette Lindesay and Prof Brendan Mackey</td>
</tr>
<tr>
<td>Environmental Policy</td>
<td>Dr Richard Baker and Prof Stephen Dovers</td>
</tr>
<tr>
<td>Integrative Methods and Practice</td>
<td>Dr Robert Dyball and Dr Kate Sherren</td>
</tr>
<tr>
<td>Natural Resource Management</td>
<td>Dr Richard Greene and Dr Sara Beavis</td>
</tr>
<tr>
<td>Society and Environment</td>
<td>Prof Peter Kanowski and Dr Jaki Schirmer</td>
</tr>
<tr>
<td>Graduate Diploma in Environmental and Resource Economics</td>
<td>Crawford School of Economics and Government</td>
</tr>
<tr>
<td>Graduate Diploma in Environmental Management and Development</td>
<td>Crawford School of Economics and Government</td>
</tr>
<tr>
<td>Graduate Diploma in Environmental Law</td>
<td>Faculty of Law</td>
</tr>
<tr>
<td>Graduate Diploma in Geographical Sciences</td>
<td>ANU College of Medicine, Biology &amp; Environment</td>
</tr>
<tr>
<td>Graduate Diploma in Science, specializing in</td>
<td>ANU Colleges of Science</td>
</tr>
<tr>
<td>Forestry</td>
<td>Dr Richard Greene</td>
</tr>
<tr>
<td>Geography</td>
<td></td>
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<tr>
<td>Human Ecology</td>
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<tr>
<td>Resource and Environmental Management</td>
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<table>
<thead>
<tr>
<th>Master programs by coursework</th>
<th>Academic Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master of Applied Anthropology &amp; Participatory Development (MAAPD)</td>
<td>School of Archaeology and Anthropology and Resource Management in Asia-Pacific Program (RMAP)</td>
</tr>
<tr>
<td>Master of Climate Change</td>
<td>Crawford School of Economics and Government and ANU College of Medicine, Biology &amp; Environment</td>
</tr>
</tbody>
</table>
| Master of Environment, specializing in | ANU College of Medicine, Biology & Environment and ANU Colleges of Science
| Integrated Assessment Modelling | Dr Barry Croke and Prof Tony Jakeman
| Water Science and Management | Prof Tony Jakeman and Dr Lachlan Newham
| Global Change | Dr Janette Lindesay and Prof Brendan Mackey
| Environmental Policy | Dr Richard Baker and Prof Stephen Dovers
| Integrated Methods and Practice | Dr Robert Dyball and Dr Kate Sherren
| Natural Resource Management | Dr Richard Greene and Dr Sara Beavis
| Society and Environment | Prof Peter Kanowski and Dr Jacki Schirmer
| Master of Environmental and Resource Economics | Crawford School of Economics and Government
| Prof Quentin Grafton |
| Master of Environmental Law | Faculty of Law
| Pgadmin.law@anu.edu.au |
| Master of Environmental Management and Development, specializing in: | Crawford School of Economics and Government
| Natural Resources | Dianne Dunne and A/Prof Luca Tacconi
| Economics and Business |
| Water Management |
| Governance and Policy |
| Climate Change |
| Society and Environment |
| Law and Policy |
| Master of Environmental Science | ANU College of Medicine, Biology & Environment and ANU Colleges of Science
| Science.Enquiries@anu.edu.au |
| Master of Geographical Sciences | ANU College of Medicine, Biology & Environment and ANU Colleges of Science
| Science.Enquiries@anu.edu.au |
| Master of Natural Hazards | Crawford School of Economics and Government, ANU Colleges of Science, and Research School of Earth Sciences
| Dr Sara Pozgay and Dr Doracie Zoleta-Nante |
| Master of Public Policy, specializing in: | Crawford School of Economics and Government
| Policy Analysis | Dr John Uhr and Maurette MacLeod
| Development Policy |
| Economic Policy |
| Social Policy |
| Environmental Policy |
| Industry Strategy |
| International Policy |
| Environmental Law |
| Master of Science, specializing in | ANU Colleges of Science
| Geosciences | earthsci.gradprog@anu.edu.au
| Science Communication |
| Master of Science, specializing in Environmental Science | ANU College of Medicine, Biology & Environment and ANU Colleges of Science
| Dr Richard Greene |
Postgraduate environmental / water-related courses offered in ANU

For postgraduate studies, ANU offered a wide-range of environmental and water-related courses across the different colleges and schools. Most of these courses have substantial ‘water’ and ‘environmental’ components. Courses highlighted in blue and bolded are directly water-related.

### Postgraduate courses Area of water-related courses offered by different ANU Colleges

<table>
<thead>
<tr>
<th>School of Sociology</th>
<th>School of History</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMO8088 Population, Climate Change and Sustainable Development</td>
<td>HIST6129 Country Lives: Australian Rural History</td>
</tr>
<tr>
<td>DEMO8002 Population Policy and Planning</td>
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<table>
<thead>
<tr>
<th>School of Archaeology &amp; Anthropology</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCH6041 Introduction to Environmental Archaeology</td>
</tr>
<tr>
<td>ANTH8049 Issues in the Design and Evaluation of Development Projects and Programs</td>
</tr>
<tr>
<td>ANTH8259 Introduction to Australian Indigenous Policy</td>
</tr>
<tr>
<td>ANTH8030 Critically Assessing Contemporary Development Practice</td>
</tr>
<tr>
<td>ANTH8016 MAAPD Internship</td>
</tr>
<tr>
<td>ARCH8019 Practical Studies in Social Analysis</td>
</tr>
<tr>
<td>ARCH8033 Archaeology, Climate Change and Society</td>
</tr>
<tr>
<td>BIAN6119 Nutrition, Disease and the Human Environment</td>
</tr>
<tr>
<td>HUMN8001 Interdisciplinary Humanities Research: Methods, Theories and Skills</td>
</tr>
<tr>
<td>HUMN8003 Cultural and Environmental Heritage: Key concepts and practices</td>
</tr>
<tr>
<td>HUMN8004 Connections to Country: Understanding Indigenous heritage in Australia</td>
</tr>
<tr>
<td>HUMN8005 Cultural Landscapes</td>
</tr>
<tr>
<td>HUMN8006 Cultural and Environmental Heritage Field Practice</td>
</tr>
<tr>
<td>HUMN8007 Cultural and Environmental Heritage Research Project</td>
</tr>
<tr>
<td>HUMN8009 Development in Practice</td>
</tr>
<tr>
<td>HUMN8018 Cultural and Environmental Heritage: Extended Research Project</td>
</tr>
<tr>
<td>HUMN8019 World Heritage: Conserving cultural heritage values</td>
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</tbody>
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<table>
<thead>
<tr>
<th>School of International Political &amp; Strategic Studies</th>
<th>School of Culture, History and Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTR8028 Global Environmental Politics</td>
<td></td>
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<tr>
<td>ASIA8025 Key Problems in Society and the Environment</td>
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<thead>
<tr>
<th>Crawford School of Economics and Government</th>
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</thead>
<tbody>
<tr>
<td>ANTH8028 Introduction to Social Impact Studies</td>
</tr>
<tr>
<td>ANTH8038 Introduction to Gender and Development</td>
</tr>
<tr>
<td>ANTH8039 Exploring Gender and Development</td>
</tr>
<tr>
<td>ANTH8044 Environmental Management and Indigenous Peoples</td>
</tr>
<tr>
<td>ANTH8047 Resource Projects and Indigenous Peoples</td>
</tr>
<tr>
<td>CRWF8001 Economic Globalisation and the Environment</td>
</tr>
<tr>
<td>CRWF8006 Climate Change Policy Economics</td>
</tr>
<tr>
<td>CRWF8007 Australian Water Conflicts</td>
</tr>
<tr>
<td>CRWF8013 Water Economics &amp; Governance</td>
</tr>
<tr>
<td>CRWF8004 Case Studies in Economic Policy</td>
</tr>
<tr>
<td>EMDV8001 Environmental Sustainability, Health and Development</td>
</tr>
<tr>
<td>EMDV8002 Methods for Environmental Decision-Making</td>
</tr>
<tr>
<td>EMDV8003 Sustainable Development</td>
</tr>
<tr>
<td>EMDV8027 Environmental Accounting and Planning</td>
</tr>
<tr>
<td>EMDV8078 Introduction to Environmental and Resource Economics</td>
</tr>
<tr>
<td>EMDV8101 State, Society &amp; Natural Resources</td>
</tr>
<tr>
<td>EMDV8102/8010 Tools &amp; Processes for ERM</td>
</tr>
<tr>
<td>EMDV8103 Environmental Assessment</td>
</tr>
<tr>
<td>EMDV8106 Issues in Development</td>
</tr>
<tr>
<td>EMDV8007 Environmental Communications</td>
</tr>
<tr>
<td>EMDV8108 Applied Env &amp; Resource Management</td>
</tr>
<tr>
<td>EMDV8104 Environmental Governance</td>
</tr>
<tr>
<td>EMDV8121 Greening of Business</td>
</tr>
<tr>
<td>EMDV8026 Environmental Science for Managers</td>
</tr>
<tr>
<td>IDEC8018 Agricultural Economics and Resource Policy</td>
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<tr>
<td>IDEC8053 Environmental Economics</td>
</tr>
<tr>
<td>HGEO8002 People At Risk from Hazards in Asia-Pacific</td>
</tr>
<tr>
<td>POGO8005 Social Policy Implementation and Service Delivery</td>
</tr>
<tr>
<td>POGO8018 Infrastructure Provision</td>
</tr>
<tr>
<td>POGO8072 Development Theories and Themes</td>
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<p>| ANU College of Business and Economics |</p>
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<thead>
<tr>
<th>School of Economics</th>
<th>School of Management, Marketing &amp; International Business</th>
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</thead>
</table>
| ▪ ECON8040 Resource & Environmental Economics  
  ▪ ECON8010 Public Economics | ▪ MGMT7007 Managing for Sustainability  
  ▪ BUSN7017 Sustainability and Corporate Social Responsibility, Accountability and Reporting |

**ANU College of Engineering and Computer Science**

<table>
<thead>
<tr>
<th>School of Computer Science</th>
<th>School of Engineering</th>
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</thead>
</table>
| ▪ COMP7310 Green Information Technology Strategies | ▪ ENGN8100 Introduction to Systems Engineering  
  ▪ ENGN6516 World Energy Resources and Renewable Technologies  
  ▪ ENGN5516 Energy Resources and Renewable Technologies |

**ANU College of Law**

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</table>
| ▪ LAWS6503 Law and the Environment  
  ▪ LAWS8108 Natural Resource: Law and Policy  
  ▪ LAWS8110 Business Strategy and Environmental Responsibility  
  ▪ LAWS8111 Env Business and Regulation  
  ▪ LAWS8113 Trade & the Environment  
  ▪ LAWS8117 Commonwealth Env Law  
  ▪ **LAWS8123 Water Resources Law**  
  ▪ **LAWS8129 Marine & Coastal Law**  
  ▪ LAWS8130 American Model of Env Law  
  ▪ LAWS8144 Environmental Responsibilities of Local Government  
  ▪ LAWS8145 Env & Risk Assessment Law  
  ▪ LAWS8146 Environmental Landuse Planning  
  ▪ LAWS8151 Culture of Environmental Law  
  ▪ LAWS8152 Indigenous Peoples & Env Law | ▪ LAWS8161 Special Topics of Env Law  
  ▪ LAWS8173 Pollution Law  
  ▪ LAWS8180 International Climate Law  
  ▪ LAWS8181 Australian Climate Law  
  ▪ LAWS8185 Forestry Law  
  ▪ LAWS8186 Site Contamination Law  
  ▪ LAWS8187 Environmental Litigation  
  ▪ LAWS8188 Environmental Markets  
  ▪ LAWS8189 Fundamentals of Env Law  
  ▪ LAWS8253 Law of the Sea  
  ▪ LAWS8264 Int Law of the Environment  
  ▪ LAWS8278 Environmental Dispute Management  
  ▪ LAWS8280 Biodiversity Law and Policy  
  ▪ LAWS8291 Special Topics in Env Law  
  ▪ LAWS8303 Graduate Research Unit (Environmental Law)  
  ▪ LAWS8312 Land, Law and Development in Asia |

**ANU Colleges of Science**

**Fenner School of Environment and Society**

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</table>
| ▪ ENVS6001 Resources, Environment & Society  
  ▪ ENVS6005 Cities and their Hinterlands  
  ▪ ENVS6013 Environment and Development  
  ▪ ENVS6019 Vegetation Ecology  
  ▪ ENVS6020 Human Ecology  
  ▪ ENVS6023 Agroecology and Sustainable Systems  
  ▪ ENVS6033 International Env Policy  
  ▪ **ENVS6034 Water Quality and Environmental Flow Assessment and Modelling**  
  ▪ ENVS6035 Application of Bayesian Networks in Natural Resource Management  
  ▪ ENVS6036 International Environmental Policy  
  ▪ ENVS6056 Ecological Measurement & Methods  
  ▪ ENVS6103 Climatology  
  ▪ ENVS6104 Australia’s Environment | ▪ **ENVS6208 Hydrology for Natural Resource Management**  
  ▪ ENVS6204 Weather, Climate and Fire  
  ▪ ENVS6301 Climate Change Field School  
  ▪ **ENVS6304 Land and Catchment Management**  
  ▪ ENVS6307 Climate Change Science & Policy  
  ▪ ENVS6514 Ecology Restoration & Management  
  ▪ ENVS6558 Farm and Urban Forestry  
  ▪ **ENVS6555 Water Resource Management**  
  ▪ ENVS6528 Environmental Policy & Planning  
  ▪ ENVS8002 Biodiversity Conservation in Modified Landscapes  
  ▪ ENVS8003 Climate Change Vulnerability & Adaptation  
  ▪ ENVS8004 Environmental Policy and Institutions  
  ▪ ENVS8005 Climate Change Science  
  ▪ ENVS8007 Climate Change: a short course |

**Research School of Chemistry**

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<tbody>
<tr>
<td>▪ CHEM8024 Environmental Chemistry</td>
<td>▪ PHYS8202 Reactor Science</td>
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**Research School of Earth Science**

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</table>
| ▪ EMSC6014 Surficial Processes, Source to Sink  
  ▪ EMSC6015 Chemistry of Earth & Oceans  
  ▪ EMSC6023 Global Cycles II: The Modern | ▪ EMSC6029 Introduction to Earth Science in the Field  
  ▪ EMSC6107 The Blue Planet  
  ▪ EMSC8004 Current Topics in Geophysical |
3) Professional development of DEWHA

In 2008 the ANUWI, in collaboration with University of Canberra, completed a professional course in key areas of water (hydrology, environmental flows, institutions, and water trading) for the Department of Environment, Water, Heritage and the Arts. The course was a great success and an expanded version was delivered again in 2009 and 2010. An overview of the course is outlined, below.

**Water Resources, Management and Planning: An Introduction**
Series of seven lectures each of 1.5 hours duration  
*Contact person: Professor Quentin Grafton*

Course outline:
1. Water reform in Australia – the context *(Dr Daniel Connell)*
2. The hydrological cycle and water policy *(Dr John Williams)*
3. Water planning and environmental issues *(Prof Richard Norris)*
4. Water markets and trading in the Murray-Darling Basin *(Prof Quentin Grafton)*
5. Indigenous interests and water planning *(Dr Sue Jackson)*
6. Urban water *(Prof Quentin Grafton)*
7. Climate change and water *(Prof Amanda Lynch)*

**Modelling and Managing Water in the Murray-Darling Basin (advanced)**
Series of three lectures each of 1.5 hours duration  
*Contact person: Professor Quentin Grafton*

Course outline:
1. Allocating water under the challenges of climate change and climate variability *(Dr John Williams)*
2. Challenges of using environmental flows to achieve ecological outcomes *(Dr Michael Stewardson)*
3. Economics of water modelling in the Murray-Darling Basin *(Prof Quentin Grafton)*
4) Global Development Learning Network (GDLN)

GDLN is a partnership of over 120 recognized global institutions, collaborating in the design of customized learning solutions for people working in development. GDLN-Australia, based within the Crawford School at the ANU in Canberra is the Australia node in the global network. They provide trainings and courses in various topics including water. Details see http://www.crawford.anu.edu.au/gdln/

ANUWI Website

The ANUWI website (www.water.anu.edu.au) provides a platform for information exchange between water researchers, practitioners, students and the public. Website information includes:

- Background of ANUWI
- Updated events and activities
- Past conference or workshop presentation
- Water related publication of WI members
- Updated international water conferences, workshops, funding and scholarship opportunities and information

If members would like to share any water news with our communities or post items on the website, please feel free to contact us.

New ANU Water Initiative website is launched in 2010
## 2009 ANU water events

There were a wide variety of water seminars, workshops and public lecturers on offer in 2009, with just a selection listed below.

<table>
<thead>
<tr>
<th>Date</th>
<th>Speaker</th>
<th>Topics</th>
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<tbody>
<tr>
<td><strong>ANU Public Lecture/Events</strong></td>
<td></td>
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<tr>
<td>10 Mar</td>
<td>Prof Marc Mangel, University of California, Santa Cruz</td>
<td>Public Lecture: Ecology, conservation and public policy: A vision for the 21st century</td>
</tr>
<tr>
<td>21 April</td>
<td>Binayak Ray</td>
<td>Seminar: The politics of emerging water scarcity in South Asia Synopsis</td>
</tr>
<tr>
<td>21 April</td>
<td>Prof Will Steffen, ANU</td>
<td>ResearchFest Public Lecture: Global change &amp; the earth system: surviving the anthropocene</td>
</tr>
<tr>
<td>3 July</td>
<td>Jamie Pittock, Dr Kuntala Lahiri-Dutt Dr Nargis Akhter Ekram Chouhury</td>
<td>Public Lecture: The data, the denial and the future? Let there be light! Tipaimukh Dam: the socio-economic and environmental impact</td>
</tr>
<tr>
<td>24 Aug</td>
<td>ANU Media</td>
<td>Media Release: Nanotubes help to solve desalination problem</td>
</tr>
<tr>
<td>21 Oct</td>
<td>Various speakers</td>
<td>ANU National Water Week 2009</td>
</tr>
<tr>
<td>21 Oct</td>
<td>Rod Quantock, Comedian, Writer and Climate Change Activist</td>
<td>National Water Week Lecture - Thirsty work</td>
</tr>
<tr>
<td>2 Nov</td>
<td>ANU Media</td>
<td>Media Release: Drought tolerant plant gene discovered</td>
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<tr>
<td>16 Nov</td>
<td>Prof Tony McMichael and Prof John Mackenzie</td>
<td>Public Lecture: Climate change and global health</td>
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<tr>
<td><strong>Centre for Aboriginal Economic Policy Research</strong></td>
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<tr>
<td>February</td>
<td>Dr Jon Altman, ANU</td>
<td>Commercial water and Indigenous Australian: A scoping study of licence allocation</td>
</tr>
<tr>
<td>4 Mar</td>
<td>Dr Jon Altman, ANU</td>
<td>Seminar: Fresh water in the Maningrida Region: Ameioriating intercultural contestation over values and property rights</td>
</tr>
<tr>
<td>17 June</td>
<td>Adrian Fordham, Bill Fogarty</td>
<td>Indigenous ecological knowledge and western science: Critical foundations for the development of sustainable wildlife enterprises in remote Indigenous communities</td>
</tr>
<tr>
<td>June</td>
<td>Jon Altman, Sean Kerins, Emilie Ens, Geoff Buchannan, and Katherine May</td>
<td>Submission to the Review of the National Biodiversity Strategy: Indigenous people’s involvement in conserving Australia’s biodiversity</td>
</tr>
<tr>
<td>14 Oct</td>
<td>Adrian Fordham, Bill Fogarty</td>
<td>The development of sustainable wildlife enterprises in remote Indigenous communities of Australia: A case study</td>
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<tr>
<td><strong>College of Law</strong></td>
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<tr>
<td>3 April</td>
<td>Dr Tim Stephens, University of Sydney</td>
<td>Ocean acidification: An acid test for international law</td>
</tr>
<tr>
<td>3 Aug</td>
<td>Various speakers</td>
<td>Conference: Climate change – policy choices &amp; politics</td>
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<tr>
<td>11 Aug</td>
<td>Dr Jaye Ellis, McGill University</td>
<td>Sustainable development and the promise of integration</td>
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<tr>
<td><strong>Crawford School of Economics and Government</strong></td>
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<tr>
<td>2 Feb</td>
<td>Prof Quentin Grafton and various speakers</td>
<td>Water Market Workshops</td>
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<tr>
<td>Date</td>
<td>Speaker/Organisation</td>
<td>Event</td>
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<tr>
<td>10 Feb</td>
<td>Stale Navrud, Norway; Steve Hatfield-Dodds, Canberra; Axel Michaelowa, Switzerland</td>
<td>Environmental Economics Research Hub Annual Workshop</td>
</tr>
<tr>
<td>10 March</td>
<td>Prof Marc Mangel, UC Santa Cruz</td>
<td>Toyota-ANU Public Lecture: Ecology, conservation and public policy</td>
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<tr>
<td>4 April</td>
<td>Dr Daniel Connell ANU</td>
<td>Federal hydrological systems: why are they so difficult to manage?</td>
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<tr>
<td>6 April</td>
<td>Prof Jeff Bennett ANU</td>
<td>Non-market environmental valuation: dispatches from the trenches of policy application</td>
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<tr>
<td>12 May</td>
<td>Dr Steve Morton, CSIRO</td>
<td>Climate change and natural resources management: What are the roles of science?</td>
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<tr>
<td>25 May</td>
<td>Qiang Jiang ANU</td>
<td>Modelling water resource allocation in the Murray-Darling Basin</td>
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<tr>
<td>25 August</td>
<td>Dr Wilfrid Legg OECD</td>
<td>The sustainable management of water in agriculture: an OECD perspective</td>
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<tr>
<td>15 Sept</td>
<td>Prof Stephen Howes, Ligang Song, &amp; Jane Golley ANU</td>
<td>China and the environment</td>
</tr>
<tr>
<td>24 Sept</td>
<td>Prof Richard Norris University of Canberra</td>
<td>DEWHA Executive Training Program: Water planning &amp; environmental issues</td>
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<tr>
<td>21 Oct</td>
<td>Various speakers</td>
<td>National Water Week – ANU Seminar Day</td>
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<tr>
<td>23 Oct</td>
<td>Dr John Williams</td>
<td>DEWHA Executive Training Program: Hydrological cycle and water policy</td>
</tr>
<tr>
<td>27 Oct</td>
<td>Richard Cornes ANU</td>
<td>Aggregative environmental games</td>
</tr>
<tr>
<td>27 Oct</td>
<td>Maria A. García-Valiñas Toulouse School of Economics, INRA-LERNA</td>
<td>EERH Seminar: Rationing and length: the impacts of water supply interruptions on residential users</td>
</tr>
<tr>
<td>13 Nov</td>
<td>Amanda Lynch</td>
<td>DEWHA Executive Training Program: Climate change and water</td>
</tr>
<tr>
<td>11 Dec</td>
<td>Prof Quentin Grafton ANU</td>
<td>DEWHA Executive Training Program: Water markets and trading</td>
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**Fenner School of Environment and Society**

<table>
<thead>
<tr>
<th>Date</th>
<th>Speaker/Organisation</th>
<th>Event</th>
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<tbody>
<tr>
<td>25 June – 19 Nov</td>
<td>Clem Davis</td>
<td>Weekly weather briefing</td>
</tr>
<tr>
<td>12 Mar</td>
<td>Tally Plamer, University of Technology Sydney</td>
<td>Exploring methods and concepts that will take integration practice forward in natural resource management</td>
</tr>
<tr>
<td>11 May</td>
<td>Dr Polly Ericksen, ANU</td>
<td>Public Lecture: Vulnerability of food systems to global environmental change</td>
</tr>
<tr>
<td>11 June</td>
<td>Mira Durr</td>
<td>It’s a party in there – archaea and bacteria biogeochemical interactions in acid sulphate soils</td>
</tr>
<tr>
<td>30 July</td>
<td>Jamie Pittcock, ANU</td>
<td>Seminar: Conflicts and synergies between national climate change policies and sustainable water management</td>
</tr>
<tr>
<td>20 Aug</td>
<td>Dr Peter Wothers</td>
<td>National Science Week Public Lecture: Just add water</td>
</tr>
<tr>
<td>17 Sept</td>
<td>David Rheinheimer, University of California</td>
<td>Sierra Nevada watershed management, regional climate warming and adaptation</td>
</tr>
<tr>
<td>2 Oct</td>
<td>Dr Phillip A Arkin, University of Maryland</td>
<td>Observing the global hydrological cycle: Uncertainties and projections</td>
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<tr>
<td>8 Oct</td>
<td>Dr Lorenzo Borselli, Borselli Research Institute</td>
<td>State of the art and future development of erosion modelling in Italy and Europe</td>
</tr>
<tr>
<td>8 Oct</td>
<td>Dr Baihua Fu ANU</td>
<td>EXCLAIM2 – A tool for assessing climate change impacts on natural resources at a regional scale</td>
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<tr>
<td>Date</td>
<td>Speaker/Presenter/Contributor</td>
<td>Topic/Event</td>
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<tr>
<td>15 Oct</td>
<td>Prof Neil Gunningham, ANU</td>
<td>Environmental law, regulation, governance: shifting architectures</td>
</tr>
<tr>
<td>21 Oct</td>
<td>Ms Flavia Loures LL.M, WWF International</td>
<td>The UN Watercourses Convention: in force by 2011, but will Australia ratify in the interests of better climate change adaptation?</td>
</tr>
<tr>
<td>19 Nov</td>
<td>Imran Habib Ahmad, ANU</td>
<td>Promoting development, saving the planet</td>
</tr>
<tr>
<td>23 Nov</td>
<td>Prof Edella Schlager, University of Arizona</td>
<td>Collaborative watershed management, institutions, conflict and scale</td>
</tr>
<tr>
<td>3 Dec</td>
<td>Sam Archer</td>
<td>Market based ecosystem services – A proposed National Model</td>
</tr>
<tr>
<td>4 Dec</td>
<td>Various speakers</td>
<td>Ecological Society of Australia Symposium: Ecology and environmental policy: never the two shall meet?</td>
</tr>
<tr>
<td>27 Jan</td>
<td>Dr Sara Ahmed, ANU</td>
<td>Public Lecture: Reforming water, reforming women: Does gender matter in water management in Asia and the Pacific</td>
</tr>
<tr>
<td>25 Mar</td>
<td>Kate Harriden and Kuntala Lahiri-Dutt, ANU</td>
<td>RMAP Workshop – Water Diaries: exploring the who, where and how much of household water use</td>
</tr>
<tr>
<td>24 Apr</td>
<td>Kate Harriden and Kuntala Lahiri-Dutt, ANU</td>
<td>RMAP Workshop – Water Diaries: exploring the who, where and how much of household water use</td>
</tr>
<tr>
<td>7 July</td>
<td>Zillur Rahman, ANU</td>
<td>Student Seminar – Participatory water resource management for socio-economic development in Bangladesh</td>
</tr>
<tr>
<td>18 Aug</td>
<td>Dr Tira Foran, M-Power</td>
<td>Research Seminar – Contested waterscapes in the Mekong Region: hydropower, livelihoods and governance</td>
</tr>
<tr>
<td>3 Sept</td>
<td>Mr Arnab Chakrabarty, Mr Sukanta Sarkar, Mr Dibyendu Chaudhuri, Dr Kuntala Lahiri-Dutt, Ms Kate Harriden, ANU</td>
<td>Symposium: Putting women at the centre: Gendering water</td>
</tr>
<tr>
<td>23 Sept</td>
<td>Kate Harriden</td>
<td>Water Diary 09 – call for volunteers</td>
</tr>
<tr>
<td>23 Oct</td>
<td>Dr Seema Kulkarni, SOPPECOM</td>
<td>Research Seminar – Developing a gender sensitive indicator for the water and sanitation sector: experiments with gender equity gauge</td>
</tr>
<tr>
<td>10 Nov</td>
<td>Kuntala Lahiri-Dutt ANU</td>
<td>‘Dancing with the River’ (and making a home) in the CharLands of Lower Bengal, India</td>
</tr>
<tr>
<td>18 Dec</td>
<td>Mr D.R. Karthikeyan</td>
<td>Seminar - Global food crisis</td>
</tr>
</tbody>
</table>
One of my main activities this year was field work in South Africa, south west USA and Spain made possible by a National Water Commission fellowship. This included a keynote presentation to the International conference on Environmental Flows in Pt Elizabeth South Africa in February 2009 on the political crisis unfolding in relation to environmental flows in the lower lakes of the MDB. One of the products of the Drought – Past and Future (DPF) project has been an approach to auditing the governance of large trans-boundary hydrological systems that focuses on their performance characteristics. This was the theme of a paper presented at the international drought symposium at Riverside California in March 2010 and will be the starting point for a proposed workshop in mid 2010 to discuss different approaches to auditing the governance of large hydrological systems. Staff from agencies such the National Audit Office, the Australian Productivity Commission, NSW Natural Resources Commission, Murray-Darling Basin Authority and the National Water Commission will be invited to participate.

The NWC fellowship supported my project Drought - Past and Future comparing drought management and climate change adaptation in the federal political systems of Australia, South Africa, United States, Spain/Portugal (within the EU) China, India and Brazil commenced with a two day international conference in Canberra in November 2008 which brought together many of the key researchers with whom I have working since. Among other things it will result in a single author book to be published by the CSIRO in late 2010 (working title Federal Rivers). The next phase of the DPF project commenced with an international symposium focusing on drought and climate change adaptation in March 2010 at University of California Riverside campus. The symposium was organized by Professor Ariel Dinar (ex world Bank). It is to be the beginning of a multi-year project comparing drought management in Australia, South Africa, south-west United States, Mexico and Spain. I was the keynote speaker addressing the governance theme.

Another product of the field work for the Drought Past and Future project was my contribution to the ANU’s application to UNESCO to establish a Chair in Water Economics and Transboundary Governance to be held by Professor Quentin Grafton. The travel involved in the DPF project gave me access to many of the potential partners who will be involved with the UNESCO Water Chair in the Universities of Pretoria, Eduardo Mondlane (Mozambique), California (Riverside Campus), UNESCO in the Netherlands and Wuhan University’s Research School of Environmental law the leading centre for environmental law in China. The international alliance with these universities and their intellectual input was a key component of the successful application to UNESCO.

The travel related to the DPF project was complemented by my involvement in activities related to the Japanese government funded International Lake Environment Committee. This included a keynote paper to a conference at Shiga University Japan in March and a paper presented at the 13th World Conference on lakes in Wuhan in November. ILEC has developed strong networks in South Asia, South East Asia, North Asia, Russia, Africa and South America. In 2010 I hope to develop stronger links between ILEC and the UNESCO network now evolving. In February 2010 I attended an ILEC workshop in Malaysia to discuss their plans for the next two years.
The UNESCO chair is to focus on the development of teaching programs and research projects related to achievement of the Millennium Development Goals in Africa, China, south Asia, south-east Asia and the Pacific. We plan to use the UNESCO chair to promote the ANU as a major international centre for education and research related to water economics and governance both nationally and internationally. In particular we aim to assist AusAID with implementation of its new targets for sub-Saharan Africa which include an expansion of its scholarship program for that region from 100 to 1000 scholarships per annum over the next four years.

In addition to work on international projects I continued to be involved in activities related to the development of the Murray Darling Basin Plan in 2009. This was complemented by participation in the CSIRO project commissioned by the Commonwealth to examine future water development in northern Australia as a joint author of one of the chapters of their report.

For more information, contact Dr Daniel Connell, Email: Daniel.Connell@anu.edu.au
The ANUWI Climate-Energy-Water Links Program

Barry Newell

Background

The ANUWI Climate-Energy-Water Links (CEWL) program is a response to the fast-growing recognition that a better understanding of the links between climate, energy and water is essential in any attempt to formulate energy and water policies for more resilient and adaptable societies. The aim of the program is to establish a new conceptual framework capable of supporting integrative policy-making in the climate-energy-water domain.

The specific issue that motivates the ANUWI CEWL program is the need to overcome current sector-based approaches to energy and water policy design. Water and energy are indispensable inputs to modern economies. Energy is the basic currency of the biosphere and, defined as the ability to do work, is embedded in all systems of production and consumption (Dovers 1994). Water is essential for all life, and similarly embedded in production and consumption. Many large-scale energy-conversion processes consume water, and most bulk water-supply processes require the expenditure of significant amounts of energy (Proust, Dovers, Foran, Newell, Steffen, and Troy 2007). Climate affects both the supply of, and demand for, energy and water—and energy-conversion and water-extraction processes have the potential to contribute to climate change (Marsh and Sharma 2007). There is a growing recognition, around the world, that a better understanding of the nature and possible effects of the links between climate, energy and water is essential in any attempt to formulate energy and water policies for more sustainable and adaptable societies.

The ANUWI CEWL program was initiated in October 2007 and at present comprises two projects:

The ANU-UTS CEWL Project, which involves collaboration between The Australian National University and the University of Technology, Sydney. The project began in September 2008 and will run until September 2010. The aim of this project is to assess the vulnerability of the Australian National Electricity Market (NEM) to climate change and climate-change policy. A particular focus is the likely impact of spatial differences in rainfall distribution on a transmission grid that has limited inter-regional transmission capacity.

The ANU CEWL Policy Inertia Project, which is focused on ways to help policy makers understand better the need to match (a) the time-scale for policy development in the Australian climate-energy-water system, with (b) the time available for effective climate change mitigation and adaptation. This endeavour is given urgency by the likelihood that atmospheric greenhouse-gas concentrations may have already passed thresholds beyond which positive feedback processes in the climate system can be triggered. The project involves an application of the Collaborative Conceptual Modelling (CCM) approach developed by Newell and Proust (for an initial discussion see Newell, Proust, Wiltshire, and Newell 2008).
The ANU-UTS Climate-Energy-Water Links Project

Project Team: Dr Debborah Marsh (Research Fellow, ANU-UTS CEWL Project), Dr Barry Newell (ANU), Professor Deepak Sharma (UTS), Mr Alfredo Careaga (Research Assistant, ANU-UTS CEWL Project).

During 2009 the project team focused their attention on a survey of national and international activity in water-energy research and on defining the focus of the proposed CEWL modelling project. The model will be a decision support tool capable of analysing the implications on the reliability of supply in the NEM of both carbon policies and the climate change variations across the large spatial extent of the NEM. It will take into account delays and feedbacks in the climate-energy-water system in Australia. Such characteristics are inherent in any complex system.

The project team worked on refining the modules of the model, and collecting operational data. Planned site visits to power stations in the Hunter and Central West Regions will help to validate some of the links and variables in the model. Both regions face considerable water quality and quantity issues.

During the year Marsh presented papers at a number of conferences:

a) 12th International Riversymposium, 21 September 2009, Brisbane QLD.

b) LGSA Water Management Conference, 9-11 September 2009, Deniliquin NSW.

c) IWA Water and Energy Conference, 28-30 October 2009, Copenhagen Denmark.

An ANU-UTS CEWL Project poster was included in the joint UTS-UNSW booth at COP 15, 7-18 December 2009 in Copenhagen. The ANU-UTS CEWL Project team has submitted a paper for inclusion in a special issue of *Ecology & Society* concerned with the water-energy nexus. The paper, entitled “Climate-Energy-Water: Integrating adaptation and mitigation policies in the Australian electricity sector” is focused on dynamical effects within the CEW system—in particular, the potential for unintended outcomes from climate policy, and the possibility of a future tragedy of the water commons.

The ANU CEWL Policy Inertia Project

Project Team: Dr Barry Newell, Dr Karen Hussey, Dr Katrina Proust, Professor Stephen Dovers

In the Australian CEW system, both $T_p$ and $T_a$ involve a chain of information delays and material delays. Here $T_p$ represents the characteristic time for policy development and implementation, and $T_a$ represents the time available for effective action. Delays are pervasive in complex systems and play a fundamental role in their behaviour. They provide environmental and social systems with the equivalent of physical inertia. They cause much of the counterintuitive behaviour that makes such systems difficult to understand and manage. In addition, because of their central dynamical role, delays are key leverage points for change—an increase or decrease in a critical delay can have a profound effect on system behaviour. A study of delays and relative time scales in the CEW system therefore provides a highly practical approach to integrative research and policy development in the energy and water sectors.

During 2009 Newell and Proust continued to develop their CCM approach. This emerging approach is proving to be effective in practice. It supports efforts to engage with policy makers and other complex-system stakeholders (a) in collaborative research aimed at building improved understanding of the behavioural implication of operational structures and policies, and (b) to help group members move from linear to dynamical thinking. The latter is essential to an understanding of the sources and impact of system inertia, and for an appreciation of the importance of relative time-scales in determining policy success or failure. The CCM approach will be employed in 2010 as the basis for collaborative research efforts with policy-makers in the climate-energy-water arena.
Contact: Barry Newell, Fenner School of Environment and Society, The Australian National University. Ph: +61 2 6125 4882. Mob: 0488 572 309. E: barry.newell@anu.edu.au

References


The ANU-COST Collaboration in the Energy-Water Nexus

Karen Hussey

**ANU-COST Collaboration**

Building on the ANUWI’s collaborative research project with the University of Technology, Sydney (see details, this report), and in collaboration with the Brussels-based organization COST (European Cooperation in Science and Technology), I have been developing international research opportunities focused on the energy-water nexus.

In mid-2008, COST provided funding for a series of Exploratory Workshops to examine the links between water and energy, in four key areas:

1. Energy consumption in the urban water supply chain
2. Water demands in the energy sector (excluding biomass for energy, which will be captured in the next cluster)
3. Water and energy for food security
4. Water and energy demands in other industrial sectors i.e. chemical production, paper, transport, mining, beverages...

The objective of the COST initiative is to develop a comprehensive understanding of the links within and between these four clusters, the potential trade-offs between energy and water security, and, crucially, how policy-makers and government decision-makers can best manage these links in future policies.

To date, two Exploratory Workshops have been convened. The first, in January 2009, was a larger workshop of 50 participants from various disciplines, industries and government agencies, with the aim of “unpacking” the major links between water and energy and identifying the major research initiatives in the field both within Europe, and internationally. A second workshop, in June 2009, was a smaller, invitation-only workshop convened with the aim of publishing 10-12 complementary and international case studies, which, together, highlight the complexity of energy-water interactions and which identify where better integrated policy and management strategies and solutions are needed or available.

Following the second workshop, we successfully secured a Special Issue of *Ecology and Society*, with twelve case studies currently ‘under review’. Jamie Pittock and I are guest editors for the collection, and we expect the collection to be published in mid 2010.

**Special Issue: Ecology and Society**

At the heart of the ‘energy-water’ problem is a lack of integration: the energy, water and more recently ‘climate’ sectors are highly developed within themselves but only limited effort is made to account for, and manage, the links between them. The challenge for policy-makers and industry alike is to develop effective policies, processes and analytical tools which integrate the energy-water nexus into policy and investment decisions. With a view to developing a comprehensive understanding of the issues and how policy-makers can best manage them, in this Special Edition of *Ecology and Society*, 12 case studies were identified which broadly reflect the breadth and depth of the energy-water nexus. The authors were asked to write their paper using the following framework:

1) Identify the types of energy-water interactions
2) Identify conflicting and/or synergistic interactions
3) Identify barriers to better integration
4) Identify drivers of better integration
5) Identify research gaps and priorities
6) List the key policy recommendations to foster policy better integration.

The following papers are currently under review for the special issue. All publishing costs associated with the Special Issue will be met by COST.

<table>
<thead>
<tr>
<th>Paper Title</th>
<th>Authors and Institutions</th>
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<tbody>
<tr>
<td>Synthesis Paper: Unpacking and managing the links between water and energy for resilient societies</td>
<td>Karen Hussey and Jamie Pittock, The Australian National University</td>
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</tbody>
</table>
| Food-water-energy synergies in Spain: challenges, opportunities, and creative local solutions | Anna Osann, Universidad de Castilla-La Mancha  
Maite M. Aldaya, Universidad Politécnica Madrid and the University of Twente  
Milagros Couchoud, Instituto Mediterráneo del Agua  
Paloma Esteve, Alberto Garrido, Laurent Hardy, Ana Iglesias, and Consuelo Varela, Universidad Politécnica Madrid  
Jesús Garrido, Universidad de Castilla-La Mancha |
| Climate-Energy-Water: Towards Systemic Policy and an Australian example       | Barry Newell, The Australian National University  
Debborah Marsh, University of Technology, Sydney  
Deepak Sharma, University of Technology, Sydney |
| Energy and water costs related to the cultivation of energy crops: a case study from Tuscany, central Italy | S. Orlandini, M. Mancini, F. Orlando and A. Dalla Marta, Department of Agronomy and Lana Management, University of Florence  
G. Maracchi, Foundation for Climate and Sustainability, Florence. |
| The Energy-Water Nexus in Texas (including coastal desalination and long-haul transfer) | Ashlynn S. Stillwell, Carey W. King, Michael E. Webber, Ian J. Duncan, University of Texas at Austin  
Amy Hardberger, Environmental Defense Fund |
| Underground Thermal Energy Storage (UTES) in the Netherlands: environmental risks and policy | Matthijs Bonte, Gerard van den Berg, Adriana Hulsmann and Annemarie van Wezel  
KWR Watercycle Research Institute, Nieuwegein, the Netherlands |
| Multi-dam approach to balancing power generation and ecological benefits; Penobscot River case study, Maine, USA. | Jeff Opperman, The Nature Conservancy, Global Freshwater Program  
Colin Apse, The Nature Conservancy Eastern Division Freshwater Program  
J. Royte, The Nature Conservancy Marine Field Office  
Laura Rose-Day, Penobscot River Restoration Trust |
| The Hydropower Sustainability Assessment Forum and the development of a Sustainability Protocol: a promising mechanism for optimizing energy production and sustainable use of water | Helen Locher, International Hydropower Association |
Energy and water consumption in food production: soil management as a tool for greater energy and water security
Peter Holm and Christian Bugge Henriksen, Faculty of Life Sciences, University of Copenhagen

The water footprint of sweeteners and bio-ethanol
Winnie Gerbens-Leenes, Arjen Y. Hoekstra, The University of Twente and the Water Footprint Network

The energy requirement and water footprint of a swimming pool
Winnie Gerbens-Leenes, Ballard Asare-Bediako, Yin Sun, The University of Twente

National climate change policies and sustainable water management: conflicts and synergies
Jamie Pittock, The Australian National University

Launch of the Special Issue

As part of the Spanish Presidency of the European Union, the Spanish Government invited us to launch the special issue at the 7th International ANQUA Conference, to be held 14-16 June, in Oviedo, Asturias.

An Australian launch of the special issue is scheduled to take place at the ANU in November 2010.

COST ‘Action’ Proposals

Following the success of the COST workshops, a number of participants have begun work on two funding proposals which, if successful, would secure $700k each over four years. The two proposals are:

1. Managing energy-water links in the landscape
2. Urban water management under a changing climate

For further details on any of these activities, please contact Karen.hussey@anu.edu.au
Managing Climate Risk (MCR) Project

Daniel Connell
(previously 50% ANU Water Initiative 50% Crawford School – now, as of Oct 2009, 100% Crawford School)

My main project, undertaken with support from the Hilda Johns bequest, is titled Managing Climate Risk in the world’s southern and northern temperate zones – lessons for climate change. As the MCR project has developed over the past eighteen months the UNESCO chair has become a central component. The UNESCO Chair is to provide a high profile focus point for research and teaching about water issues at the ANU. When discussing plans for possible research in the regions that are the subject of the MCR project I also asked the researchers that I was meeting to join the ANU in the application for the UNESCO chair thereby helping to build the international coalition that was an essential requirement. I also proposed that we use our joint involvement in a UNESCO chair as the organizational framework for future collaboration. As of April 2010 there is now a range of projects under way and the UNESCO chair is approved. This is a solid foundation for future development. An extension of time for the MCR project would allow these plans to mature and generate the benefits that they could potentially provide.

Within my overall project four groups of activity have been developing in parallel:-
- Managing Climate Risk (the overarching framework)
- China
- International Lake Environment Committee
- UNESCO Water Chair

(1) Managing Climate Risk

The MCR project is comparing drought management and climate change adaptation in the federal political systems of Australia, South Africa, United States, Spain (a federation within the federation of the EU) China, India and Brazil. It commenced with a two-day international conference in Canberra in November 2008 that brought together many of the key researchers with whom I have working since. During 2009 I travelled to South Africa, the United States, Spain, Portugal and the Netherlands – funded through a National Water Commission Fellowship – to undertake field research and meet with researchers in those regions.

The MCR project is providing material for a single-author book that is to be ready for publication sometime in 2011 (working title Federal Rivers). In March 2010 the research alliance which I created through fieldwork in 2009 provided the vehicle for my involvement in an international symposium focusing on drought and climate change adaptation conducted at the University of California Riverside campus. The symposium was organized by Professor Ariel Dinar (ex World Bank and also involved with the southern African universities that are joint partners in the UNESCO chair). It compared management of drought and climate variability in Australia, South Africa, United States, Mexico and Spain. I was the keynote speaker addressing the governance theme (my expenses were part-funded by the University of California).

A major part of the symposium was spent planning an ongoing project involving the research teams from the five study regions. An application for funding through the European Union’s research program seven is now being prepared. To meet the EU’s requirements the project group will be expanded to bring in teams from southern France, Italy and Greece. Even if not funded by the EU the Riverside project will still proceed. My role will be to coordinate the governance component of each of the national studies
working in combination with local researchers.

(2) China

China has been a significant focus for the MCR project and also the plans for the UNESCO Chair. Since late 2008 I have travelled to China on four occasions for discussions with staff at the Wuhan University Research Institute of Environmental Law - one of the partners in our application for the UNESCO Chair - regarding potential teaching and research collaboration. Lake Tai in the lower Yangtze basin is being investigated as a possible focus for joint work. (Lake Tai is a major lake subject to extreme water quality problems that threaten the health and livelihood of a large population in the surrounding region.) On 15th-16th of April 2010 in Canberra, with Professor Ian White, I met with and presented to a high level delegation of officials from the Chinese national government and the provinces adjoining Lake Tai that was touring Australia to investigate approaches to water quality management.

(3) International Lake Environment Committee (funded by Japan)

During 2009 I also established links with the Japanese funded International Lake Environment Committee (ILEC). I am working with ILEC because I think that the UNESCO water chair could benefit substantially from access to its strong network of water managers, researchers and NGOs in South Asia, South East Asia, North Asia, Russia, sub-Saharan Africa and Latin America. In particular it is currently developing special programs focusing on Africa and China, two key areas for the ANU - UNESCO Chair.

The Japanese government has identified lakes and reservoirs – which contain about 90% of the water utilized by humans - as the category where they can best focus their efforts. (I argued that since the Murray-Darling system no longer connects to the sea it is in effect a long thin lake.) My work with ILEC – with travel and accommodation funded by ILEC – has included:-

- a keynote paper presented to a conference at Shiga University Japan (March 2009)
- a paper presented at the 13th World Conference on Lakes in Wuhan and participation in a post- conference ILEC workshop (November 2009)
- participation in a weeklong workshop in Malaysia to discuss ILEC’s plans for the next two years, (February 2010).

The major focus of ILEC’s current program is water governance and it is planning an international symposium on that subject later in the year (location and date to be determined). In addition it is also working with governments and other international organizations in its target regions. One of the main subjects discussed in Malaysia was ILEC’s work with the Global Environment Facility (in alliance with UNDP). The GEF manages funds from developed countries provided to help developing countries meet their environmental obligations under international treaties. Currently GEF is developing guidelines for investment related to water bodies divided into five categories, trans-boundary rivers, coastal waters etc. It has asked a number of specialist international organizations to assist and ILEC is responsible for lakes and reservoirs.

(4) UNESCO Chair in Water Economics and Trans-boundary Governance

As already discussed the fieldwork for the MCR project provided the opportunity to develop links to support the UNESCO Chair application. These include teachers and researchers in the Universities of Pretoria, Eduardo Mondlane (Mozambique), California (Riverside Campus), IHE in Delft in the Netherlands and Wuhan with the Research School of Environmental law the leading centre for environmental law in China. The UNESCO chair is to focus on the development of teaching programs and research projects that will help achieve the Millennium Development Goals in Africa, China, south Asia, south-east Asia and the Pacific (with a strong focus on Africa the region that has
benefited least from recent social and economic development.). We plan to use the UNESCO chair to promote the ANU as a major international centre for education and research related to water economics and governance both nationally and internationally. In particular we aim to assist AusAID with implementation of its new targets for sub-Saharan Africa which include an expansion of its scholarship program for that region from 100 to 1000 scholarships per annum over the next four years.

**Contact**
Daniel Connell, Crawford School of Economics and Government, The Australian National University. Ph: +61 2 6125 7556. E: Daniel.connell@anu.edu.au
On 22 January 2009, Senators Penny Wong and Kim Carr announced $30M for the new National Centre for Groundwater Research and Training. The Centre is expected to start up on June 1, 2009. It is a joint venture over 5 years involving some 20 organisations, including the ANU, UNSW, UQ, CSIRO, Geoscience Australia, and the NSW and SA state governments, to be headed by Flinders University. The new knowledge generated through the NCGRT programs is intended to redress some unfortunate legacies of water resource management in Australia, namely the lack of integrated management of surface and groundwater systems and, consequently, the lack of sustainable groundwater practices that have characterised historical management. The Centre also aims to address the required training in groundwater research of Postdocs, PhDs and Honours students.

ANU leads Program 5 in the NCGRT on "Integrating Socioeconomics, Policy and Decision Support" with leading researchers from Charles Sturt University, University of South Australia and University of Western Australia. Chief Investigators are Tony Jakeman (Program Leader), Neil Gunningham, Barry Croke, Carmel Pollino and Jenifer Ticehurst (all ANU), Allan Curtis (UWA), Jennifer McKay (USA), Alex Gardner and Dave Pannell (UWA). Four research appointments have been made at ANU: Darren Sinclair, Wendy Merritt, Sondoss El Sawah and Jose-Luis Molina. Four PhD students have commenced their studies at ANU in the NCGRT. They are Emily Barbour, Rachel Blakers, Joseph Guillaume and Xiaoying Sun. See groundwater.com.au for more details of program descriptions and people in the NCGRT.

Program 5 utilises case studies to focus their integration activities. A major study is in the Namoi valley in New South Wales where ANU and CSU have secured funding from the CRC Cotton Catchment Communities to develop a decision support system that explores the effects of climate change and water policy drivers on socioeconomic and environmental conditions. A second study is in the Willunga Basin in South Australia where a process is being developed to evaluate options for determining acceptable aquifer yield. A third is for the Gnangara Mound in Western Australia where the efficacy of a water cap and trade scheme is being investigated.

The ANU is also leading the data management in the NCGRT. The University is working with the Bureau of Meteorology to develop quality assurance, reporting and visualisation capabilities for NCGRT data acquired under Superscience Funding from its various instrumented sites around the nation.

See groundwater.com.au for more details of program descriptions and people in the NCGRT.

Contact

Tony Jakeman, Integrated Catchment Assessment and Management Centre, Fenner School of Environment and Society, The Australian National University.
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The College of Science and ANU Water Initiative held the inaugural ‘ANU National Water Week’ in October 2009, bringing together high-calibre water researchers and managers from the ACT region to celebrate achievements, share knowledge, raise awareness and prepare for ACT’s water future.

With the help of enthusiastic water-loving groups and individuals within ANU, a series of fantastic events was put together to mark this special week showcasing ANU’s commitment to top-quality research and campus management of our most precious resource.

Water Week kicked off with the ‘National Water Week ANU Seminar Day’. This mini-conference, held at the Research School of Earth Sciences, featured a brilliant line-up of speakers representing ANU graduate students, the ANU Water Initiative, the ANU Fenner School, iCAM (Fenner School), Actew and CSIRO. Themed ‘Securing Our Water Future’, seminar topics covered issues such as risk assessment, decision support, policy and governance, ground and surface-water interactions, predictive modelling techniques, salinity, economics, and endangered aquatic species. A keynote address by Actew Water Security Operations Director Ian Carmody and Chief Engineer John Dymke set the tone for the day, outlining some of ACT’s key water issues and future challenges, and some of Actew’s proposed engineering solutions to growing water shortages. The following presentations were equally stimulating, demonstrating that the quality and diversity of water research in the ACT is extremely high.
To adjudicate the speakers and decide on the ANUWI Outstanding Presenter prize, we called in the expertise of experienced public speaker, author and earth scientist Dr Richard (Dick) Barwick from the Research School of Earth Sciences. Dr Barwick gave his full attention and consideration to each speaker - not easy considering the eight-hour programme - and was highly impressed with the quality of the presenters and their work. It was a difficult decision, but the end ANU PhD student Catherine Gross was awarded the prize for her excellent presentation, ‘Trade-off in drought: Perceptions of need and injustice in water distribution in Australia’.

Two standout NWW presenters, Catherine Gross (ANU Fenner School; left) and Kyle Horner (Research School of Earth Sciences; right).

Shortly following the Seminar Day proceedings the ‘ANU-Toyota National Water Week Public Lecture’ commenced, featuring comedian and climate change activist Rod Quantock. Introduced by Toyota’s Manager of Environmental Policy Manager Jon Ward, Rod had his 200-odd-member audience in stitches one moment and stunned silence the next as he explored issues surrounding climate change, water shortages, governmental policy and public action. Rod proved that comedy is indeed a powerful avenue to reach people on such a difficult and controversial subject, and don’t be fooled: he knows his stuff. Particular highlights included ANU’s Deputy Vice Chancellor Lawrence Cram’s impersonation of a raptor, Rod’s advice on barbequing Minister Steve Fielding, and creative ideas for survival in a climate catastrophe.

Comedian and climate change activist Rod Quantock presenting ‘Thirsty Work’ for the ANU-Toyota National Water Week Public Lecture, exclaiming ‘if climate change doesn’t scare the s*** out of you, then you don’t get the science!’ Rod’s lecture is available for download from the ANU Public Lecture Series podcasts webpage, or free viewing on YouTube.
After accompanying some of ANU’s principal water and earth science researchers to a lovely dinner at University House, sponsored generously by the College of Science, Rod was on his way to continue his good work in Victoria. The National Water Week committee also continued its work the following day with a stall at ANU Market Day, handing out free materials and information provided by Actew, the ANU Water Initiative, ANU Green and the ANU College of Science to students, helping to raise awareness of water research and activism on campus and promote sound water management practices. Students were happy to take free shower timers, factsheets, and household water saving tips from keen water research students Jenna Roberts, Jon Knight and Kyle Horner.

These fantastic initiatives would not have been possible without the help and support of a number of ANU groups, who helped to pull together these activities at relatively short notice. Thanks must first go to the ANU Water Initiative (particularly Noel Chan) for their ideas, administrative support, website support, advertising and sponsorship of the Seminar Day Speaker Prize; Aidan Byrne and the College of Science marketing team for designing and printing flyers and programmes, website advertising, sponsorship of the University House Dinner and bringing the wonderful Rod Quantock to Canberra; ANU Marketing representative Celeste Ecuyer for her extensive expertise and support of the ANU Public Lecture; and to the passionate water students and researchers within the Research School of Earth Sciences for their help and early support and enthusiasm to get this thing going!

We look forward to a bigger and better 2010 National Water Week!

Jenna Roberts
National Water Week 2009 Co-ordinator
E: jenna.roberts@anu.edu.au
Skukuza 2009 Workshop

Jamie Pittock

The ANU Water Initiative co-sponsored the August 2009 workshop of the Skukuza Freshwater Group, a biennial gathering of experts from academia, governments and environmental organizations from around the world to discuss a key emerging issue in freshwater conservation. The previous two Skukuza meetings focused on a) better methods for selecting freshwater habitats for conservation (USA, 2004), and b) better conservation methods for conservation of freshwater biodiversity in protected areas (South QAfrica, 2006). The 2009 workshop took these issues a step further and asked how freshwater ecosystems can be better conserved in the face of a changing climate. The Skukuza Group brings together experts from Australia, South Africa, the USA, and is now expanding to embrace Europe and China.

Skukuza 2009 was held on the estuary of the River Murray in Australia, a major Ramsar site. This "MDB" river system is severely impacted by river regulation, diversions, deteriorating water quality and climate change and so provided a thought-provoking case of the issues to be discussed at the meeting. This helped participants learn lessons from the MDB to assist in managing other over-allocated and climate change-prone rivers. The meeting reviewed the conservation status and emerging trends in climate impacts on key river systems globally. It considered how freshwater conservation methods, such as environmental flows and protected area designations, need to be adjusted to conserve aquatic ecosystems with climate change.

Skukuza 2009 was also the venue for a meeting of the International Union for Conservation of Nature’s World Commission on Protected Areas Freshwater Taskforce, looking at climate change adaptation.

As well as providing up to date scientific and policy advice into the processes of the International Union for Conservation of Nature, Ramsar Convention on Wetlands, and Convention on Biological Diversity, a special edition of Marine and Freshwater Research is due to be published in 2010 based on the workshop's papers and deliberations, documenting the state of play globally and recommended ways forward. The summary Skukuza communiqué 2009 can be downloaded from ANUWI website.

More information: Jamie Pittock – Jamie.pittock@anu.edu.au
Capital-WATER is an equal partnership between the Australian National University and the University of Canberra. WATER is an acronym for Water in Australasia: Training Education and Research.

**Its vision is to:**
- provide professional training in all areas of water-related expertise in our two institutions;
- expand and improve upon our water-related degree offerings across multiple disciplines; and
- deliver world-class water research that makes a difference in this community and beyond

**Vision**
Capital-WATER delivers training, education and research to resolve the multiple issues, socio-economic and environmental challenges of water for the benefit of Australia and its neighbours. This will be achieved by drawing on the complementarities in research and teaching at the Australian National University and the University of Canberra to deliver the world’s best practice.

**Mission**
Capital-WATER will draw on the strengths in training, research and teaching expertise at the Australian National University and the University of Canberra to:
- co-operate on water-related education and teaching.
- collaborate on joint research projects in water, particularly in association with federal and agencies and the ACT government.
- facilitate consultation and mutually beneficial co-operation when submitting and undertaking externally funded research.

**Professional Training**
Capital-WATER has provided three training courses to DEWHA in 2007 and 2008 on water
- environmental flows; institutions; hydrology, and economics

**Research**
- Capital-WATER (with support from the ANU and University of Canberra) is supporting research initiatives in energy and water, climate variability and water management, and integrated catchment management.

**Capital-WATER Co-Directors**

**Professor R. Quentin Grafton**
Co-chair, ANU Water Initiative
Professor of Economics, Crawford School of Economics and Government, ANU

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**Professor Richard Norris**
Director of the Institute for Applied Ecology at the University of Canberra
Leader of the eWater Education Program

Email: Richard.Norris@aerg.canberra.edu.au
Centre for Water Economics, Environment and Policy (CWEEP)

‘CWEEP’ pronounced ‘sweep’ as in, to survey and obtain a whole view of the world.

Our Mission
To become a leading research centre on water economics and related water policy and water governance issues; and to be part of a global network of water researchers, educators and policy makers to support water education, to strengthen water governance and to promote environmental sustainability.

Goal
The goal of the centre is to provide the world’s best technical and public policy insights into: managing water under climate variability and climate change, urban water supply and demand management, water markets, water pricing, trans-boundary water governance, and water management practices that promote environmental sustainability.

Context
The Food and Agriculture Organisation of the United Nations estimates that about 3,800 children die every day — almost exclusively in poor countries – as a direct result of unsafe drinking water and lack of proper sanitation. Without a fundamental change in how water is managed in rich and poor countries, scarcity problems will be made much worse.

Diverting water from one area or catchment to another is likely to increase in response to water scarcity. Unfortunately, in many parts of the world there are few locations where water is available without imposing substantial costs on users from where the water is being supplied, and also on the environment. The Centre will address these policy challenges by researching and supporting Australian and global efforts to effectively manage water scarcity in terms of the:

1. economics of water use, especially the trade-offs across competing users and the environment;  
2. governance of water (especially across regions within states and between states); and  
3. policies to help achieve the Millennium Development Goals in Water.

The Centre will co-ordinate and link its global activities to UNESCO-IHE, the Global Water Partnership, the International Water Management Institute, Water Net, the International Centre for Water Economics and Governance in Africa (IWEGA), and the Water for Africa Research Project. Within Australia, the centre will link its activities to the efforts of National Water Commission, Murray-Darling Basin Authority, Department of Environment, Water, Heritage, and the Arts, the Department of Agriculture, Fisheries and Forestry, and other organisations to promote integrated water resource management.
Outreach Activities
CWEEP will undertake the following activities:
1) link to and co-ordinate its activities with the ANU Water Initiative
2) generate research outputs in the form of academic publications and research reports
3) host an active website, providing policy briefs, FAQs and briefs on water economics and water policy
issues in collaboration with the UNESCO and the Global Water Partnership
4) provide professional development and executive training in water economics and governance on behalf of outside agencies.

Director of CWEEP
Professor R. Quentin Grafton, ANU.

CWEEP Research Associates
Professor Angela Arthington, Griffith University
Professor Jeff Bennett, ANU
Dr Henning Bjornlund, University of Lethridge
Drew Collins, BDA Group
Dr Daniel Connell, ANU
Dr Jeff Connor, CSIRO Land and Water
Dr Steve Cork, Ecologinsights and Australia21
Professor Allan Curtis, Charles Sturt University
Dr Katherine Daniell, ANU
Professor Stephen Dovers, ANU
Professor Ian Falconer AO, University of Adelaide
Professor Douglas Fisher, Queensland University of Technology
Professor Kevin Fox, University of New South Wales
Professor John Freebairn, University of Melbourne
Dr Marian Garcia-Valiñas, Toulouse School of Economics, France
Professor Neil Gunningham, ANU
Dr Gregory Hertzler, University of Western Australia
Dr Anthony Hogan, ANU
Dr Karen Hussey, ANU
Dr Sue Jackson, CSIRO Sustainable Ecosystems
Professor Tom Kompas, ANU
Professor Gary Libecap, University of California Santa Barbara
Professor Amanda Lynch, ARC Federation Fellow, Monash University
Professor Jennifer McKay, University of South Australia
Dr Bear McPhail, ANU
Céline Nauges, INRA-LERNA, Toulouse School of Economics (France)
Dr Barry Newell, ANU
Dr William Nikolakis, ANU
Professor Richard Norris, University of Canberra
Dr Robert O’Brien, Percat Water
Jamie Pittcock, ANU
Professor Hugh Possingham, ARC Federation Fellow, University of Queensland
Professor John Quiggin, ARC Federation Fellow, University of Queensland
Dr Ejaz Quereshi, CSIRO Land and Water
Paul Ryan, Interface NRM
Dr Hugh Sibly, University of Tasmania
Dr Caroline Sullivan, Southern Cross University NSW
Dr John Ward, CSIRO Sustainable Ecosystems
Dr Sarah Wheeler, University of South Australia
Dr Michael Ward, ANU
Professor Ian White, ANU
Dr John Williams, John Williams Scientific Services Pty Ltd
A network based at the ANU that brings together students, water researchers and water professionals in gender & water issues.

The Gender Water Network (GWN) links students, professionals and researchers with interest related to gender concerns in water resource management. It welcomes all water professionals and academics from Australia to join and share their expertise with others.

This includes a gendered view of farming, irrigation, community-based water management, national and local water policies, and intra-household allocation, use and interests in water. It includes a awareness of the gendered effects of climate change and mobilizes public opinion on mainstreaming gender in all water related issues. Lastly, GWN links researchers with interest on gender issues in water and sanitation.

GWN was established by Kuntala Lahiri-Dutt, a Fellow at the Resource Management in Asia Pacific Program, in 2003 after the successful 'Fluid Bonds' Workshop held at ANU to celebrate the connections between gender and water in the International Year of Freshwater. In this well-attended workshop, participants shared experiences, case studies and stories about the significant role of gender in water management in Australia and the Asia-Pacific Region. The workshop was accompanied by the launch of the Fluid Bonds booklet, which outlined in simple words many of the crucial issues linking gender and water.

The members of the GWN network have a primary focus in the developing countries in the Asia-Pacific region. However, increasingly the commonalities in the gender concerns in water resource management between Australia and the wider Asia-Pacific region are being appreciated. The GWN is growing as interest arises from students, researchers and professionals working in the field. It now acts as a major voice in 'engendering' the water management sector in the region, as a clearinghouse of information and a platform for sharing common experiences. It has over 250 members, who regularly check the site and keep in touch, and receives a number of visitors to the site. Currently, the ANU members are from: Resource Management in the Asia Pacific program (RMAP); College of Asia and the Pacific (CAP) and rest of the ANU

Other members are spread all over the Asia Pacific region as well as from all around the world and include water professionals. Anyone with interest in gender and/or water can join the GWN. Students in particular are encouraged to join the GWN and to share their experiences.

Website info/ join GWN: http://rspas.anu.edu.au/gwn/

Contact:
Dr Kuntala Lahiri-Dutt, Fellow, Resource Management in Asia-Pacific Program, ANU
Email: kuntala.lahiri-dutt@anu.edu.au
National Centre for the Groundwater Research and Training (NCGRT) is one of the national partnerships of Integrated Catchment Assessment and Management Centre and Society (iCAM), which is a major node in the Fenner School of Environment and Society at the ANU.

ANU leads Program 5 in the NCGRT on "Integrating Socioeconomics, Policy and Decision Support" with leading researchers from Charles Sturt University, University of South Australia and University of Western Australia. Chief Investigators are Tony Jakeman (Program Leader), Neil Gunningham, Barry Croke, Carmel Pollino and Jenifer Ticehurst (all ANU), Allan Curtis (UWA), Jennifer McKay (USA), Alex Gardner and Dave Pannell (UWA). Four research appointments have been made at ANU: Darren Sinclair, Wendy Merritt, Sondoss El Sawah and Jose-Luis Molina. Four PhD students have commenced their studies at ANU in the NCGRT. They are Emily Barbour, Rachel Blakers, Joseph Guillaume and Xiaoying Sun.

Program 5: Integrating Socioeconomics, Policy and Decision Support

Another area being tackled by the NCGRT involves community attitudes to groundwater management, and the complex area of the social, economic and policy dimensions of groundwater resource management. Program Five is where the learnings from the other four programs are brought together to inform the ways we understand and make decisions about groundwater. Social scientists, environmental lawyers and policymakers will work closely with other researchers on identifying issues and developing acceptable options. The program is closely aligned with a priority of the National Water Initiative to optimise economic, social and environmental outcomes for water management through a national regulatory and planning system.

Flagship case studies will link with other programs to examine socioeconomic and ecological factors to help formulate effective policy and management practices. A key focus will be on how to reduce uncertainty in groundwater decision making. Researchers will also look at specific issues such as ways to engage the farming community around the need for sustainable groundwater management. Other issues such as trans boundary groundwater involving multiple stakeholders is a potential minefield which requires a long-term strategic approach. This will be the focus of a case study in South Australia’s Lower South East which has an over allocated groundwater system as well as cross jurisdictional issues.

Sub-program 5A: Integrated Assessment Modelling and Decision Support
Sub-program 5B: Farmers of the Future: How will they farm groundwater?
Sub-program 5C: Policy, Institutional, Law and Governance issues
Sub-program 5D: Vulnerability, Risk, Sensitivity and Uncertainty Issues in Integrated Management of Groundwater

See P.38 of ANUWI Projects Section for project update.

See www.groundwater.com.au for more details of program descriptions and people in the NCGRT.

For enquiries about Program 5, contact Tony Jakeman, E: Tony.Jakeman@anu.edu.au
UNESCO Chair in Water Economics and Transboundary Water Governance

“Overcoming poverty is not a gesture of charity. It is an act of justice. It is a protection of a fundamental human right, the right to dignity and a decent life.”

Nelson Mandela

Overview

The UNESCO Chair in Water Economics and Transboundary Water Governance was officially launched by the Hon. Bob McMullan, the Australian Parliamentary Secretary for International Development on 15 April 2010. The UNESCO Chair is a four-year program (renewable) that links the Australian National University; UNESCO’s International Hydrological Programme (IHP) and Institute for Water Education (IHE); WaterNet; International Center for Water Economics and Governance in Africa (IWEGA) at University of Eduardo Mondlane; the International Water Management Institute; Wuhan University, China; University of Pretoria, South Africa; the Global Water Partnership; Water for Africa Research Project at University of London; and the Global Development Learning Network in a research, training and capacity building and knowledge transfer partnership in Southern Africa and China.

It creates a pole of excellence in water economics and governance in Africa and China to meet the Millennium Development Goals (goals 3 and 7) and to provide socio-economic expertise in: (1) Water Education Training with capacity building and knowledge transfer in water economics and water governance; and (2) ‘Water and Society’ with a development focus on understanding the value of water and trade-offs across water users and between water use and the environment with a special focus on gender equity.

To achieve its goals to promote sustainable development and better water management, the project will provide: (1) in-country (especially in Southern Africa) flexible-learning courses in water economics and transboundary water governance that will build issues of gender equity into the course structures; (2) create a student exchange program; (3) support web-based learning modules with the Global Water Partnership and International Water Management Institute (4) create interactive, flexible learning modules in water economics, water governance and gender equity in integrated water resource management in collaboration with the Global Development Learning Network housed by the World Bank Institute; and (5) develop internship programs for water professionals from the South.

Context

The Food and Agriculture Organization of the United Nations estimates that about 3,800 children die every day - almost exclusively in poor countries - as a direct result of unsafe drinking water and lack of proper sanitation. Africa has the largest disparities in water availability and least coverage in potable water supply and sanitation. Without a fundamental change in how water is managed, scarcity problems will be made much worse with a growing world population and climate change that will increase the frequency and severity of droughts with potentially calamitous effects on food production in the South, especially Africa.

As the water available decreases, water conflicts will be exacerbated among users. Diverting water
from one area or catchment to another is likely to increase in response to water scarcity. Unfortunately, in many parts of the world there are few locations where water is available without imposing substantial costs on users from where the water is being supplied, and also on the environment.

The UNESCO Chair addresses three key issues in water scarcity: (1) the economics of trade-offs across competing users and between water use and the environment to help achieve the Millennium Development Goals in Water; (2) the governance of water (especially across regions within states and between states); and (3) inequalities of water access and use, especially those based on gender.

The project will co-ordinate with WaterNet and UNESCO-IHE and link the Global Development Learning Network, the Global Water Partnership, the International Water Management Institute’s work on transboundary governance (especially in Africa) and Wuhan University’s work on the Yangtze River, the University of Pretoria interdisciplinary expertise in water and its partnership with the International Center for Water Economics and Governance in Africa (IWEGA) at the University of Eduardo Mondlane, the Water for Africa Research Project, University of London with its expertise integrated water management and gender equity, and Australian expertise in water economics and experience in the governance of the Murray-Darling Basin to provide: (1) high-level capacity building (South-South & North-South) in water governance and economics that will help achieve the Millennium Development Goals; (2) knowledge transfer and exchange between Australia, China and Southern Africa on water governance; (3) new insights about how to effectively manage water scarcity across boundaries; and (4) establish a pole of excellence in water economics and governance in Africa to complement the existing programs (MSc and short courses) of UNESCO IHE and WaterNet that are primarily in the sciences, engineering and law.

**Long-term Goal**

The long-term goal of the UNESCO Chair is to help achieve Millennium Development Goals. The aim is to promote environmental sustainability and gender equality by supporting socio-economic-environmental resilience and sustainable development in Africa and Asia. This will be achieved by improving water governance and the capacity of current and future water professionals and policy makers.

**Specific objectives**

1. To increase the skills, capacity, networks and potential of leaders and prospective water managers and policy makers, through a co-ordinated suite of learning modules addressing key issues in water economics (water markets, water pricing, valuation), governance (especially transboundary issues, climate variability) and gender equity in integrated water resource management;
2. To strengthen and sustain institutional capacity (especially in Southern Africa), by providing a platform for collaboration and institutional development via professional courses, student exchanges, professional internships and flexible learning with the Global Water Partnership and the Global Development Learning Network; and
3. To develop innovative research, tools, case-studies and insights on water economics, water governance and gender equity that extends global knowledge and supports integrated water resource management.

**Planned Activities**

The project will include the following activities:

1. Postgraduate teaching programme focused on Millennium Development Goals 3 and 7 through a graduate course in water economics and water governance at the Australian National University offered in collaboration with Wuhan University, China and University of Pretoria;
2. Short-term training through a jointly taught (Australia/China and Australia/China/Southern Africa) intensive courses in water economics, governance, and gender equity in integrated water resource management;
3. Research through the publications of the UNESCO Chair and project team and partners;
4. Visiting professorships through a short-term scholar exchange program for Southern Africa and Chinese scholars;
5. Scholarships through the provision of a PhD scholarship on Water Sustainability; and
6. Institutional development through collaboration with the Global Water Partnership, Global Development Learning Network and International Water Management Institute to deliver interactive learning, tools, knowledge sharing and professional water internships.

**People**

![Professor R. Quentin Grafton, ANU](image1)
**Nominated Chairholder**

![Dr Daniel Connell, ANU](image2)
**Director of Education programs**

![Jamie Pittock, ANU](image3)
**Director of International Programs**

**Key individuals among the partners include:**

1. **Professor Wang Shuyi**, Wuhan University is a Member of the Standing Committee of Hubei Provincial People's Congress and Vice Chair of the Chinese Association of Environment and Resource Law.
2. **Professor Rashid Hassan**, University of Pretoria is an expert on water economics and water use efficiency and water valuation. He is a Member of the Academy of Science, South Africa and Chief Editor of the African Journal Agricultural and Resource Economics.
3. **Mark Giordano**, Head of Institutions and Policy Group at International Water Management Institute is a geographer and economist with extensive experience in economic development, water management and transboundary resources.
4. **Dr Frances Cleaver**, Director of Water for Africa Research Project, University of London is one of the world’s leading researchers in gender equity and water resource management. All partners will work actively and collaboratively with the International Hydrological Programme at UNESCO.
5. **Dr Stefano Farolfi**, Scientific Director, International Center for Water Economics and Governance in Africa (IWEGA), Universidade Eduardo Mondlane.
6. **Professor Innocent Nhapi**, Department of Civil Engineering, University of Zimbabwe. His research interests include transboundary water quality monitoring, Eco-technology research in Africa, and catchment water quantity and quality management.
7. **Professor Dominic Mazvimavi**, Director Institute of Water Studies, University of the Western Cape, South Africa. He is one of Africa's leading experts on environmental flows and river flows. He serves as the Managing Guest Editor for the Journal of the Physics and Chemistry of the Earth. Prof Mazvimavi has research interests on water resources planning and management, hydrological regionalization, effects of land-use change on runoff, and environmental flow assessment. He has previously worked as a Senior Research Fellow at the Harry Oppenheimer Okavango Research Centre of the University of Botswana, and Senior Lecture at the University of Zimbabwe. Prof Mazvimavi plays a very active role in WaterNet, which is a SADC initiative aimed at developing IWRM capacity through postgraduate and short-term training programmes.

**Governance**

An Advisory Council is being established that will provide advice and oversight to the activities of the UNESCO Chair. Details on membership of the Advisory Council will be provided in the near future.

ANUIE – Climate Impacts Program
Water availability and climate change

The Question:
What will happen to water availability with climate change?

The Background:
One expected impact of climate change is an increase in near-surface air temperature and world-wide measurements show that warming has generally occurred. What impact will warming have on water availability? Currently, there is a very widespread belief amongst the broader community that because of this warming, water will evaporate faster thereby reducing the availability of water. This has become dogma, e.g. it is routinely reported in the media, it forms the basis of many policy-orientated debates, it appears to be largely accepted by the public at large, etc.

Why Scientific Input is Urgently Needed:

If the dogma were true, then measurements of the evaporation of water from meteorological pans should show an increasing trend over the last 30 to 50 years when most of the warming has occurred. The first study to critically examine this question in Australia was by two ANU researchers (Roderick & Farquhar, 2004, International Journal of Climatology, 24: 1077-1090). They reported that on average, pan evaporation had declined. This trend is not unique to Australia. On the contrary, it is very widespread, and an averaged decline in evaporative demand has been reported for the United States, former Soviet Union, Canada, China, India, Thailand and New Zealand amongst other places. Thus, while it has become warmer, the evaporative demand has not, on average, increased, and in many places it has decreased.

The Relevance:

In a dry country like Australia, changes in water availability have immediate impact on virtually all of our social, economic and natural systems. It is very difficult to study climate change impacts until one has attempted to address the most basic question of all; Wetter or Drier?

Michael Roderick & Graham Farquhar
Research School of Biological Sciences
The Australian National University
Contact: Michael.Roderick@anu.edu.au
Members of ANUWI are researchers and educators who are working or studying in ANU on water-related issues. They come from a broad spectrum across different disciplines and colleges in the university. Below are the summaries of some members’ water-related research activities and publications in 2009. Publications and updates from these and other members are also available at the ANUWI website www.water.anu.edu.au.

**Geoffrey Adams**

Centre for Mathematics and its Applications, Mathematical Sciences Institute  
Email: Geoffrey.Adams@anu.edu.au

**Activities and impacts**

**Publications**

**Sara Beavis**

ANUWI: Lecturer, Hydrology and Water Resources Management, Fenner School of Environment and Society  
Email: Sara.Beavis@anu.edu.au

**Research Interest**
- Impacts of landuse and land management change on catchment hydrology  
- Impacts and management of acid sulfate, saline, and sodic soils  
- Soil physical properties as controlling mechanisms on the flow of water and solutes  
- Water quality of estuarine systems  
- The sources, fluxes and transformations of recycled water

**Activities and impacts**
1. Speaker, Goldschmidt Conference, Vancouver, 13-17th July 2008  Effects of inundation and desiccation on salt cycling in a saline disposal basin, Loveday Lagoon, South Australia  
3. Education and Training Leader and Executive Committee Member, CRC LEME.  
4. Project lead (with Prof David Ellis, RSES), Environmental Trust funded project Sewage Effluent: Impacts on land, estuaries and beaches, Merimbula, NSW  
5. Project lead (with Prof David Ellis, RSES) ASSISTM environmental science education project South Coast region, NSW  
6. Project investigator (with NSW DECCW)  Groundswell Project (linking urban waste production and rural soil amelioration)
Publications


Convened Courses

- ENVS2008/6208 Hydrology for Natural Resources management (with Ian White)
- ENVS3005/6555 Water Resources Management
- EMSC3028 Coastal Environmental Earth Science (with David Ellis)

Jeff Bennett

Professor, Crawford School of Economics and Government
Email: Jeff.Bennett@anu.edu.au

Research Interest

- Water economics
- Environmental values

Activities and impacts


Teaching

- Introduction to Environmental and Resource Economics
- Government, Markets and Global Change

Publications

## Daniel Connell

**Lecturer, Crawford School of Economics and Government**

**Email:** Daniel.Connell@anu.edu.au

**Research Interest**
- People and their environment in the Murray-Darling Basin 1750 - 2050.
- Cultural and institutions dimensions of water management
- The design of institutions involved with environmental management.
- International cross-jurisdictional water management and related cultural, economic, political and environmental issues.
- The hydrological dimensions of climate change

**Activities and impacts**
See section *Report from Research Facilitator*

**Publications**

## Barry Croke

**Senior Lecturer, Department of Mathematics and The Fenner School of Environment and Society (iCAM)**

**Email:** Barry.Croke@anu.edu.au

**Research Interest**
- predicting flow in ungauged catchments
- groundwater / surface water interactions
- water quality (including pathogen transport)
- model evaluation in the presence of uncertainty

**Activities and impacts**
1. Co-organiser of a session titled “Adapting model complexity to the available data: approaches to model parsimony” at the European Geophysical Union General Assembly, Vienna, Australia, 19-24 April, 2009.
2. Co-organiser of a session titled “Prediction in ungauged basins - review of progress and plans for the future” at the 18th IMACS World Congress and MODSIM09 International Congress on Modelling and Simulation, Cairns, Australia, 13-17 July, 2009.

**Publications**


Katherine Daniell
Research Fellow, Centre for Policy Innovation
Email: Katherine.Daniell@anu.edu.au

Research Interest
- Water policy and multi-level governance
- Participatory process organisation and evaluation
- Integration of technical and non-technical approaches to water management
- Sustainability policy, decision-aiding and risk management
- Innovation, learning and human adaptation processes

Activities and impacts
1. Publishing Fellow, Fenner School of Environment and Society, ANU (February-August 2009) and visiting researcher at Cemagref UMR G-EAU Montpellier, France.
2. Guest editor, Special Feature in Ecology and Society on “Implementing participatory water management: recent advances in theory, practice and evaluation”
3. Speaker, 32nd Hydrology and Water Resources Symposium, 3 Dec 2009

Publications
R. Quentin Grafton

Co-Chair, ANUWI; Director, Centre for Water Economics, Environment and Policy, and Professor of Economics, Crawford School of Economic and Government
Email: Quentin.Grafton@anu.edu.au

Research Interest
- Water pricing
- Water markets and water economics
- Climate adaptation and water

Activities and Impacts

Presentations
9. Presentation “Determinants of Residential Water Demand in OECD Countries”, 3 June 2009, OECD.

Teaching: Water related courses
- CRWF 8013 – Water Economics and Governance
- IDEC 8018 – Agricultural Economics and Resource Policy
- Professional courses: (1) Water Markets in the Murray-Darling Basin; (2) Urban Water; (3) Economic Modelling in the Murray-Darling Basin

Media Releases and Articles
- “Murray Darling needs more: economist”, West Australian, 17 February 2009.
- Quentin Grafton interviewed on ABC702 Sydney, 16 February 2009
- Quentin Grafton interviewed on ABC666 Canberra, 18 February 2009
- Quentin Grafton mentioned in “River needs cash: Economist says more money needs to be spent on Murray-Darling”, Sunraysia Daily, 18 February 2009
- Quentin Grafton mentioned in “Murray needs more water”, Bendigo Advertiser, 18 February 2009
- Quentin Grafton mentioned in “Murray-Darling needs more cash”, Daily Advertiser, 18 February 2009.
- Quentin Grafton mentioned in “Murray-Darling needs more economist”, Sydney Morning Herald, 18 February, 2009
- Quentin Grafton writes “$10bn Murray buyback vital for land and economy”, Canberra Times, 6 February, 2009
- Quentin Grafton Interviewed on WIN News regarding “Sustainable Future – Water Workshop”, 10 March 2009
- Quentin Grafton was interviewed on WIN News, 9 October 2009
- Quentin Grafton mentioned in “Going cheap – but this water sale must end”, Adelaide Advertiser, 22 March 2010

Publications
Catherine Gross

PhD Scholar, Fenner School of Environment and Society
Email: Catherine.Gross@anu.edu.au

Research Interest
- Fairness and justice in environmental decision-making
- Water allocation in natural resource management

Activities and Impacts
1. Prize for the best paper presentation at the ANU College of Law Postgraduate Conference “Law & Change”, Canberra, June 11-12, 2009: "Listening for a change? Perceptions of injustice in water distribution decisions"
2. Video presentation for the Ecological Society of America Millennium Conference 2009 "Water-Ecosystem Services, Drought, and Environmental Justice" (available on ESA YouTube Channel: http://www.youtube.com/user/ESAVideos)
4. Submitted PhD, February 18, 2009, titled: "Water under the bridge: fairness and justice in environmental decision-making"

Karen Hussey

Research Fellow, Crawford School of Economics and Government
Email: Karen.Hussey@anu.edu.au

Research Interest
- Water policy, governance and management
- Links between water policy and other sectors i.e. energy, agriculture, services
- EU environmental policy
- Global environmental governance
- EU-Australia trade and business relationship (ARC project)

Activities and Impacts
- Most significant output: a baby girl (Tara) – nine months in the preparation, finally born October 2009!
- Co-Chair ANU Water Initiative
- Co-Chair, International Steering Committee, ANU-COST project Climate-Energy-Water Links
- Steering Committee Member, ANU-UTS project on energy-water links
- Expert Evaluator, Framework Programme 7
- Convenor, international conference 'Accounting for, and managing, the links between energy and water', January 2009, Brussels
- Guest Editor, Special Issue of *Ecology and Society* (in press)
- Guest Editor, Special Issue of the *Australian Journal of International Affairs* (in press)
- Presenter, World Climate Congress, 10-12 March 2009, Copenhagen
- Presenter, Annual CEPS (Centre for European Policy Centre) Energy Conference, March 2009, Brussels
- Presenter, European Technology Platform conference, May 2010 Brussels

**Publications**

- *Water Resources Planning and Management* (Cambridge University Press), forthcoming 2010, co-edited with Quentin Grafton

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**Karen Ivkovic**

**Departmental Visitor, Fenner School of Environment and Society (iCAM)**

**Email:** kardami@optusnet.com.au

**Research Interest**

I'm a "Departmental Visitor" and am collaborating with iCAM (Barry Croke, Tony Jakeman) within the Fenner School on some journal papers, and earlier, on water system modelling course materials for ICEWaRM. My main interest is in surface-groundwater interactions. I bring ~20 years of experience in hydrogeology/hydrology within the private, government and academic sectors. I have worked as a researcher and manager, and I have a keen interest in the science-policy interface.

**Publications**

### Tony Jakeman

**Professor, ANUWI and iCAM, Fenner School of Environment and Society**  
**Project Leader, National Centre for Groundwater Research and Training**  
**Email:** Tony.Jakeman@anu.edu.au

**Research Interest**
- Integrated Modelling, Assessment and Decision Support
- Hydrological Modelling

**Activities and Impacts**
- Vice-President, International Association for Mathematics and Computers in Simulation.

**Publications**

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### Qiang Jiang

**PhD Candidate, Crawford School of Economics and Government**  
**Email:** Qiang.Jiang@anu.edu.au

**Research Topic**
Water management in the Murray Darling Basin

**Activities and Impacts**
Qiang Jiang commenced work towards a PhD in July 2007, supervised by Professor Quentin Grafton at the ANU. Her research examines the optimal land and water use of the Murray Darling Basin under climate change. Research in 2009 focused on developing an integrated water model for the Murray Darling Basin.

**Publication**
Pamela Katic
PhD Candidate, Crawford School of Economics and Government
Email : Pamela.Katic@anu.edu.au

Research Topic
Optimal spatial extraction of natural resources with an application to groundwater.

Activities and Impacts
Pamela Katic commenced work towards a PhD in March 2008, supervised by Professor Quentin Grafton at the ANU. Her research examines the role of spatial dynamics in the design of optimal resource extraction policies. Research in 2009 focused on estimating the divergence between competitive and optimal rates of extraction from common pool resources under alternative spatial representations. An application of the model to a real-world aquifer shows the importance of recognizing spatial heterogeneity in resource extraction problems.

Conference Publication

Kuntala Lahiri-Dutt
Research School of Pacific and Asian Pacific (RSPAS)
Email : Kuntala.Lahiri-dutt@anu.edu.au

Research Interests
Optimal spatial extraction of natural resources with an application to groundwater.

Activities and Impacts
• Performed duties as the Steering Committee member of Gender Water Alliance.
• Participated in the 5th World Water Forum in March, 2009 in Istanbul, Turkey and presented in two sessions.

Publications

Wee Ho Lim
PhD Candidate, Research School of Biology
Email : Wee-ho.Lim@anu.edu.au

Research Interests
• Environmental physics
• Ecohydrology

Activities and Impacts
• Australian Water Association (ACT Branch) Post Graduate Student Awards 2009 - Runner Up
• Delegation of ANU to Fudan University - Nominated by Dean of Science to represent The Australian National University to present a poster at ANU Day (3rd November 2009) at Fudan University (Shanghai, China)
Publications


D.C. “Bear” McPhail

Reader/Associate Professor, ANUWI & Research School of Earth Sciences
Email: Bear.McPhail@anu.edu.au

Research Interests

- Groundwater dynamics: recharge, flow, discharge, groundwater-surface water interaction
- Development of element and isotope geochemical techniques for understanding groundwater environments
- Impacts of groundwater extraction, irrigation and other land use on salinisation
- Groundwater geochemistry for mineral exploration

Activities and Impacts

- Chief investigator on ARC Linkage Grant to study groundwater dynamics in the Lower Murrumbidgee catchment, NSW (partner with Parsons Brinckerhoff Pty Ltd)
- Authored and co-authored a series of papers presented at the 10th Australasian Environmental Isotope Conference and 3rd Australasian Hydrogeology Research Conference, Perth, Western Australia, December 2009
- Steering Committee member, ANU Water Initiative
- Session organizer, Australian Earth Sciences Convention 2010: “Water resources, viability and threats, with emphasis on groundwater”
- Co-convenor, Water Science and Policy Major/Double Major, ANU
- Convenor, Groundwater (3rd-year undergraduate course, ANU) and Co-convenor, Environmental Chemistry (2nd-year undergraduate course, ANU)

Publications

Barry Newell
Visitor Fellow, Fenner School of Environment and Society
Email: Barry.Newell@anu.edu.au

Research Project
Dr Barry Newell is a physicist who has a background in dynamical systems, astrophysics, mathematics education, operations research, and management. He has 20 years’ experience in astronomical research followed by some 14 year’s work in industrial process improvement. Since 2003 he has been concerned with management in complex social-ecological systems.

Activities and Impacts
Details see ANUWI Climate-Energy-Water Link Program.

Jamie Pittock
PhD Scholar, Fenner School of Environment and Society
Email: Jamie.Pittock@anu.edu.au

Research Topic
Integrating management of rivers and climate change.

Activities and Impacts
Jamie Pittock commenced work towards a PhD in October 2007, supervised by Professor Stephen Dovers and Dr Karen Hussey at the ANU and Dr Lara Hansen from EcoAdapt. His research examines the conflicts and synergies between sustainable river management and climate change policies. Research in 2009 focused on:
- the energy-water nexus;
- autonomous adaptation in six international river basins;
- conflicts and synergies between national policies in nine nations;
- application of the 1997 UN Watercourses Convention in climate change adaptation;
- effectiveness of multi-lateral environment agreements in managing climate change and water;
- climate change adaptation in the River Murray;
- environmental water demand management;
- - periodic relicensing of water infrastructure as a climate change adaptation measure.

Conferences/Seminars/Workshops
- 4 February 2009, Murray Darling Basin Authority, Canberra. Presentation on biodiversity, water and climate change adaptation.
- 23 February 2009, Implementing Environmental Water Allocations conference, Port Elizabeth, South Africa. Presentation on environmental water demand management.
- 27 February 2009, WWF e-flows training workshop, Paarl, South Africa. Presentation on “Environmental flows and climate change”.
- 5 March 2009, University of East Anglia, Norwich, UK. Presentation on “Lessons for climate change adaptation from better river basin management.”
- 11 March 2009, Copenhagen Climate Change Congress, Denmark. Session chair and presentation on “Lessons for climate change adaptation from better river basin management.”
20 April 2009. 3rd Yangtze Forum, Shanghai. Presentation on conflicts & synergies between national climate change policies and river basin management.

6 May 2009. ANU Public Seminar, Report back on adaptation discussions from: Climate change: global risks, challenges and decisions, at the University of Copenhagen.

9 June 2009. COST Energy – Water Nexus Workshop, Brussels. Presentation on “Conflicts and synergies between national climate change policies and sustainable water management.”

7 July 2009. International Association of Research Universities’ Global Summer Program.

Lecture on "An NGO perspective on international environmental policy development.”

3 July 2009. ANU Bangladeshi Seminar: public presentation on “The Tipaimukh Dam: the international and Indian context.”

30 July 2009. ANU Fenner School seminar on “Integrating management of rivers & climate change: national policies.’

25 August 2009. ANU National Europe Centre, Climate change and migration workshop.

Presentation on: “Climate change & migration: UN Watercourses Convention.”


14 October 2009. Department of Climate Change: presentation on “Integrating management of rivers & climate change: national policies”


Publications

- Plus a bi-monthly freshwater environment feature article in Water21 magazine for the International Water Association.

Jenna Roberts

PhD Candidate, Research School of Earth Sciences
Actew Aspi Baria PhD Scholar winner
Email : Jenna.Roberts@anu.edu.au

Research Interests

- Wastewater management and water quality
- Anthropogenic contamination of freshwater systems
- Characterisation of endocrine disrupting compounds (EDC’s) in freshwater, wastewater, biosolids, soils and sediments
- Analytical techniques for analysis of ultratrace organic compounds
Activities and Impacts

- Internship, CSIRO Land and Water SA – collaborative research and training in EDC characterization, Jan-Mar 2010
- Attendance at Australasian Society for Ecotoxicology conference, Sept 2009
- Contributions to Actew and Ecowise planning workshops, 2009
- Co-ordinator, ANU National Water Week, October 2009

Michael Roderick & Graham Farquhar (Team)

Research School of Earth Sciences, Research School of Biology
Email: Michael.Roderick@anu.edu.au; Graham.Farquhar@anu.edu.au

Team
Professor Graham Farquhar, Dr Michael Roderick, Dr Fubao Sun, Dr Chin Wong, Mr Peter Groeneveld, Mr Wee-Ho Lim, Mr Randall Donohue

Research School of Biology & Research School of Earth Sciences

Activities
- We continued our ARC-funded research program on changing water availability and evaporative demand throughout 2009 as detailed in the publications.

Awards
2009 Australasian Science Prize awarded to Dr Michael L. Roderick
Award Citation: For overturning assumptions about the effects of climate change on evaporation rates and for research on changes in water availability.

2009 Land & Water Australia Senior Research Fellowship to Professor Graham Farquhar

2009 Runner-up in the Australian Water Association Post-Graduate Student Awards to Mr Wee-Ho Lim for his “Global Water Atlas”

Publications

Books

Journal Articles
Conferences


Consultancies

- Dr Michael L. Roderick & Professor Graham D. Farquhar, Murray Darling Basin Authority, invited consultancy on Water Availability & Evaporative Demand

Andrew Ross

PhD Candidate, Fenner School of Environment and Society
Email: a.ross@anu.edu.au

Research Topic
Andrew is carrying out a PhD study of integrated surface and groundwater management and use in the Murray Darling basin and western states of the USA. This study is examining factors that influence integration of surface and groundwater management, with special emphasis on institutional factors including property rights, laws, operational rules and management organisations. [http://fennerschool-people.anu.edu.au/rossa/word/cwm.php](http://fennerschool-people.anu.edu.au/rossa/word/cwm.php)

Activities and Impacts

- Andrew has completed his PhD proposal paper and part 1 of the PhD following initial consultation and interviews with government water managers, industry representatives and academic experts.
- Presented PhD proposal to Commonwealth and State agencies in Canberra, Sydney, Melbourne and Adelaide in February and March 2009
- Attended Fenner Conference on the Environment, Canberra 10-12 March 2009
- PhD Proposal Seminar, Fenner School of Environment and Society, 19 May 2009
- Seminar on Adaptive and Integrated Water Management in the Murray Darling Basin, Mekong River Commission, Vientiane, Laos, 10 November 2009
- Attended National Groundwater Forum, Canberra 24-25 November 2009
- Attended Workshop on Systemic and Adaptive Water Governance, Melbourne, 14 December 2009
- During April and May 2010 will carry out consultations and interviews in Arizona, Colorado, Idaho and California.
Publications

- **Ross, A. and P. Martinez-Santos (2009).** “The challenge of groundwater governance: case studies from Spain and Australia”, online first *Regional Environmental Change.* http://www.springerlink.com/content/f32h8188p4kh188f/?p=73f37ac053f64a029a73c0cca54ec2d3&pi=18


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**Will Steffen**

Professor, ANU WI and ANU Climate Change Institute

Email : Will.Steffen@anu.edu.au

Research Interests

- Earth System science
- Integrated approaches to climate change adaptation and mitigation

Activities and Impacts

- Produced update on climate change science for Department of Climate Change in mid-2009; include update on influence of climate change on Australian rainfall patterns.
- Co-authored paper on the concept of planetary boundaries for defining a “safe global operating space” for humanity; human appropriation of water resources was one of the 9 planetary boundaries identified.

Publications


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**Janet Stein**

Fenner School of Environment and Society

Email : Janet.Stein@anu.edu.au

Research Interests

- Conservation of riverine ecosystems
- Development of improved methods of spatial analysis for rivers and catchments

Activities and Impacts

- Co-organizer (with Richard Kingsford and Jamie Pittock) of Skukuza 2009, Global Wetlands and Rivers Expert Conference, Goolwa, South Australia, September, 2009
- Developed the National Catchment Boundaries and associated raster stream network - key components of the Bureau of Meteorology’s Australian Hydrological Geospatial Fabric
- Mapped in-stream structures that potentially impede fish passage in the Murrumbidgee River catchment upstream of Burrimjuck Reservoir for an ACT Government project assessing ecological connectivity in the ACT
Publications

**Jess Weir**

Research Fellow, Native Title Research Unit, Australian Institute of Aboriginal and Torres Strait Islander Affairs; Visiting Research Fellow, Fenner School of Environment and Society

Email: Jess.Weir@aiatsis.gov.au

Research Interests
- Indigenous water issues, including consumptive, cultural and environmental water
- Cultural attitudes to water
- Water policy, governance and management

Activities and Impacts

Jessica Weir’s book *Murray River Country* was launched at the Melbourne Writers’ Festival by John Doyle and Monica Morgan on 29 August 2009, and at the AIATSIS conference in Canberra by Dr Payi–Linda Ford in 30 September 2010. In association, Dr Weir was interviewed by The Age, National Indigenous Television, Radio National (Late Night Live), ABC Radio Newcastle, Canberra, and Riverland, Radio 3KND Melbourne, Radio Adelaide, and The ANU Reporter.

Presentations

Publications
- **Weir, J.** (2009). ‘Our understandings of water and how they translate into our
decision making’, workshop paper, ACT Planning and Land Authority workshop

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**Michael Woodward**
PhD Scholar, College of Medicine, Biology and the Environment  
Email: u4321269@anu.edu.au

**Research Project**  
Climate Change: Water and Wellbeing
- I am currently conducting research into how domestic water restrictions and related Climate Change themes affect other people in everyday life.
- I am also interested in finding out more about perceptions of current and future climate change related themes. Data is currently being collected in the ACT, NSW and QLD.
Economics of Water Resources, Volumes I and II

Edited by R. Quentin Grafton
Publisher: Edward Elgar, UK
Published date: 2009

Quentin Grafton brings together more than 90 previously published articles in this two volume collection on the economics of water resources. The articles featured cover a vast range of subjects, locations and methodologies and are divided into nine broad theme areas including environmental valuation, water pollution, irrigation, residential and non-residential water use and water pricing and management.

During a period of increased international environmental awareness and change, this collection identifies the most important and influential pieces and will be an invaluable resource for students and water professionals alike. 95 articles, dating from 1967 to 2008 Contributors include: G. Brown, R. Carson, A. Dinar, R. Griffin, M. Hanemann, N. Hanley, C. Howe, R. Mendelsohn, A. Xepapadeas, R. Young, D. Zilberman

Information source: Edward Elgar Publishing

Computational Methods in Water Resource Assessments: An Exercise Kit

Edited by Teemu Kokkonen, Anthony J. Jakeman, Harri Koivusalo and John P. Norton
Publisher: iEMSs
ISBN: 978-88-903574-0-4
Published date: 2009

Computational methods for water resource assessments – an exercise kit is an exercise book that attempts to (i) develop skills, and (ii) impart an understanding of, the use of computational methods in water resource assessments. The motivation for this book lies in the firm belief of the value in learning by doing. The exercises are developed in a way that encourages readers to explore what happens ‘behind the scenes’ in environmental simulation models. Hence in many exercises the computational procedures are built almost from scratch before applying the model to a particular problem. It is believed that gaining understanding of how computational methods used in environmental assessments actually work not only promotes readers’ potential to develop their own applications, but also increases their skill to assess critically existing environmental simulation models. Many of the exercises are also built on real data measured in the field. This approach hopefully increases the readers’ interest in the subject as well as their appreciation of uncertainties, and even sheer errors, appearing in measurements.

Information source: International Environmental Modelling and Software Society (www.iemss.org)
An Atlas of the Global Water Cycle: Based on the IPCC AR4 Models

Authored by Wee Ho Lim and Michael L. Roderick
Publisher: ANU E Press
ISBN 9781921536885 (Print version); ISBN 9781921536892 (Online)
Published date: July 2009

The Atlas contains maps and tables that document model predictions contributed by international climate modelling groups to the 2007 4th Assessment Report of the Intergovernmental Panel on Climate Change. The predictions are made available here via the wonders of the internet and ongoing cooperation by the international climate modelling community who routinely archive their results.

The maps and tables in the Atlas document rainfall, evaporation and runoff estimates for the 20th century along with predictions of the same quantities at the end of the 21st century. Whatever your interest, we hope you find the Atlas as helpful as we do.

Information source: ANU E Press (http://epress.anu.edu.au/)

Ecohydrological Regionalisation of Australia: A Tool for Management and Science

Edited by Brad J. Kennard, Mark J. Kennard, Janet L. Stein, Julian D. Olden, S.J. Mackay, Mike F. Hutchinson and Fran Sheldon
Publisher: Land and Water Australia
ISBN: 9781921544736
Published date: April 2009

This report is a result of the Ecohydrological regionalisation of Australia project. River classifications identify the key features that make rivers different or similar and so provide a tool by which the insights and knowledge gained in one river or region may be meaningfully applied or transferred to another. This project proposes to develop a regional classification of Australia's rivers based on ecologically relevant aspects of their hydrology (i.e. an ecohydrological classification).

This project classified Australia’s unregulated riverine flow regimes to provide a rigorous foundation for future ecological investigations of the importance of the flow regime, testing of scenarios associated with projected future climate change and application to management of the nation’s water resources. Two alternative approaches to this task were used.

Climate Change 2009: Faster Change & More Serious Risks

Authored by Will Steffen
Publisher: Department of Climate Change, Australian Government
Published date: July 2009

This document reviews and synthesises the science of climate change since the publication of the IPCC's AR4, with an emphasis on rapidly changing areas of science of direct policy relevance. In that regard, the report is selective; it highlights a small number of critical issues rather than attempting to be comprehensive across the full range of climate science. The report is focused more strongly on issues of importance to Australia, although it places these in a global context.

The synthesis is based primarily on scientific papers published since the IPCC's AR4, along with selected earlier papers required to provide context to the synthesis.

Information source: ANU Climate Change Institute (http://www.anu.edu.au/climatechange/) and Department of Climate Change (www.climatechange.gov.au/)

Murray River Country: An Ecological Dialogue with Traditional Owners

Authored by Jessica K. Weir
Publisher: Aboriginal Studies Press, Canberra
ISBN: 9780855756789
Published date: September 2009

*Murray River Country* discusses the water crisis from a unique perspective – the intimate stories of love and loss from the viewpoints of Aboriginal peoples who know the inland rivers as their traditional country. These experiences bring a fresh narrative to contemporary water debates about the Murray-Darling Basin, and how we should look to more sustainable ways to live in Australia as our approach to water is changing in the face of water scarcity, drought, climate change, and water mismanagement. This book brings new insights to these issues by focusing our attention on what Indigenous people from along the Murray are experiencing, saying, and doing.

Weir wants to move readers beyond questions of how much water will be 'returned' to the rivers, to understand that our economy, and our lives, are dependent on river health. She uses different knowledge traditions to reveal unacknowledged assumptions that trap our thinking and disable us from acting. By engaging with the Murray-Darling Basin, Australia's agricultural heartland, *Murray River Country* goes to the core of our national understandings of who we are and how we can live in this country.

Information source: Australian Institute of Aboriginal and Torres Strait Island Studies (www.aiatsis.gov.au/)
Northern Australia Land and Water Science Review 2009
Full Report

Over 80 contributing authors
Publisher: CSIRO and Northern Australia Land and Water Taskforce
Published date: October 2009

The Northern Australia Land and Water Taskforce commissioned a comprehensive review of northern Australian land and water science. Referred to as the Northern Australia Land and Water Science Review 2009, the project was coordinated by CSIRO in collaboration with over 80 of Australia’s leading scientists working on northern land and water issues. The Science Review represents the most comprehensive and thorough review ever undertaken of conventional science and knowledge of issues relevant to the sustainable development of northern Australian land and water.

Various ANU researchers have contributed to the review, including:
Ch7: Indigenous interests in land and water
Jon Altman, Kirrily Jordan, Sean Kerins, Geoff Buchanan, Nicholas Biddle, Emilie-Jane Ens & Katherine May

Ch17: A primer for water institutions and governance: concepts, definitions and measures
R. Quentin Grafton, John Ward, Sam McClennon and Jim McColl

Ch22: Experiences with integrated river basin management, international and Murray darling Basin: lessons for northern Australia
Erin Bohensky, Daniel Connell, Bruce Taylor

Ch23: The case for a revised National Water Initiative for northern Australia
Daniel Connell, Quentin Grafton, John Ward

Ch28: A robust framework for sharing water in northern Australia
John Ward, Jim McColl, William Nikolakis, Bruce Taylor, Nick Abel, R. Quentin Grafton

Information source: Northern Australia Land and Water Taskforce
(www.nalwt.gov.au/)
### Water Links

#### Australian Capital Territory
| Environment ACT                  | www.environment.act.gov.au |
| ACTEW                           | www.actew.com.au           |
| ActewAGL                        | www.actewagl.com.au        |
| ACT Water Portal                | www.water.act.gov.au       |
| Waterwatch                      | www.act.waterwatch.org.au  |
| Capital-WATER                   | www.capitalwater.anu.edu.au|

#### Australian Federal and State Agencies
| NSW Living Thing                | www.livingthing.net.au     |
| NSW Environment Protection Authority | www.epa.nsw.gov.au/stormwater |
| Melbourne Water                 | www.melbournewater.com.au  |
| South Australia Department of Water Land and Biodiversity Conservation | http://www.dwibc.sa.gov.au/ |
| Western Australia Water Corporation | www.watercorporation.com.au |

#### International
| International Year of Freshwater Official Site | www.wateryear2003.org |
| World Water Day                              | www.worldwaterday.org   |
| Earth Day Network                             | www.earthday.net        |
| EdNA for Schools                              | www.edna.edu.au/schools/themes/water.html |
| ADB Water in Small Island Countries           | www.adb.org/Water/theme3.asp |
| Dialogue on Water and Climate                 | www.waterandclimate.org  |
| World Water Council                           | www.worldwatercouncil.org|
| Global Water Partnership                      | www.gwpforum.org        |
| World Submit on Sustainable Development       | www.johannesburgsummit.org |
| Pacific Water Association                     | www.pwa.org.fj          |
| UNEP                                          | freshwater.unep.net/    |
| UNESCAP Water and Mineral Resources Section   | www.unescap.org/enrd/water_mineral/water_mineral.htm |
| UNESCO International Hydrological Program     | www.unesco.org/water     |
| UNU International Network on Water, Environment and Health | www.inweh.unu.edu/inweh |
| WHO Water, Sanitation and Health Program       | www.who.int/water_sanitation_health |
| WMO Hydrology and Water Resources Programme    | www.wmo.ch/web/homs/index.html |
| WSSCC                                         | www.wsscc.org            |