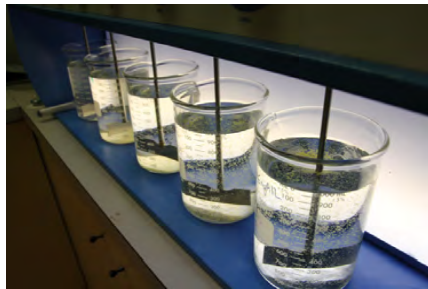


THE UNIVERSITY OF
NEW SOUTH WALES



2008 Annual Report

UNSW Water Research Centre



water@
UNSW
water research centre



Table of Contents

	Page
1) Directors Report	3
2) Industry Advisory Committee	4
3) About WRC	7
3.1 Our Structure	
3.2 Our Program Areas	
4) Highlights	9
4.1 Awards & Honours	
4.2 Staff Focus	
4.3 Research Initiatives	
5) Research Grants for 2008	22
6) Our Staff	27
6.1 WRC Staff - Kensington	
6.2 WRL Staff - Manly Vale	
6.3 Visitors	
6.4 PhD Students	
7) Publications	33
8) Financial Report	42





1) Directors report

The year 2008 saw the initiation of the UNSW Water Research Centre, established on the strong foundation of 60 years of leading Australian water research by the School of Civil and Environmental Engineering's hydrology group, the Centre for Water and Waste Technology and the Water Research Laboratory. This new research centre will enable us to better coordinate and develop the diverse aspects of water engineering research undertaken within our School.

As Co-Directors, we are very grateful to all staff for maintaining their focus and commitment to maintaining the high quality of investigations undertaken within the centre during its formation and restructure.

The WRC continued its excellent record of research success in 2008, as measured by research grants, direct industry funding, publication impacts and awards. We are justly proud of the achievements of our staff during the year.

Australian Research Council (ARC) awarded centre staff over \$2.8M in new Discovery and Linkage funding during 2008 for strategic fundamental research as well as completing over \$5.5M of directly commissioned research for industry and government.

A outstanding new initiative for 2008 was commissioning of the Australian Climate Change Adaptation Network for Settlements and Infrastructure (ACCARNSI), led and co-ordinated by Associate Prof. Ron Cox. The Infrastructure node of ACCARNSI is jointly convened by the WRC co-Directors.

In 2008, we have welcomed new staff members, Dr. Matthew McCabe, Dr Chris Blenkinsopp, Rita Henderson, Luis Mallon-Lopez, Conrad Wasko and Stephen Pells.

The WRC also hosted many international visitors including Dr. Seyed Ali Azarmsa (Tarbiat Modares University, Tehran), Associate Prof Carlos Chernicharo (Federal University of Minas Gerais, Brazil), Associate Professor Jorg Drewes Colorado School of Mines, Colorado, USA and Dr Eric Dickenson (Colorado School of Mines).

We wish to take this opportunity to publically thank our stakeholders and funding agencies for their support during this very successful year.

We look forward to the new opportunities which will emerge from the formation of the UNSW Water Research Centre.



Bill Peirson
Co-Director, WRC



Richard Stuetz
Co-Director, WRC

Vision Statement

Australia's water future will require synthetic understanding coupled with innovative approaches to all aspects of the water cycle; water use and re-use; aquatic environments; flooding; estuaries and the coast.

Our vision for the UNSW Water Research Centre is to continue UNSW's 60 year history of leading water research within a holistic perspective of water from catchment to ocean."





2) Industry Advisory Committee

The UNSW Water Research Centre is a large multidisciplinary water research group and plays a major role in the training of Australia's future water engineers. The water industry in Australia underpins the entire Australian economy. WRC derives approximately 60% of its total research funding directly from industry and 20% of its revenues from industry partnership revenues.

Consequently, the UNSW WRC is advised by senior water industry leaders who advise the co-Directors regarding strategies to ensure the ongoing relevance of the centre and its ability to address and anticipate contemporary Australian water issues. Our present industry advisory committee members are as follows:



Angus Gordon

Chair

Completing a Civil Engineering degree in 1969 Angus commenced work on water and coastal projects in 1970 at WRL. In 1973 he obtained a Master of Engineering Science and in 1973 took up positions at MHL and then in Coastal Branch of Public Works NSW. For 40 years he has been involved in coastal engineering, coastal zone management and planning projects in all states of Australia and in Brunei, Dubai, Kuwait, Indonesia and Hong Kong. He has also been engaged by the UN as an international expert.

In 1976 he established the NSW Governments Beach Improvement Program and led the team that, in 1978 produced NSW's first comprehensive coastal investigation and management study the "Byron Bay – Hastings Point Erosion Study. As a direct result of that study Angus then became involved in the drafting and implementation of the 1979 NSW Coastal Protection Act. Angus has 45 technical papers published nationally and internationally on coastal engineering and coastal zone management.

First becoming involved in the issue of climate change in 1976, he was seconded to the Antarctic Division of the Department of Science for a 12 month period. In 1987 he published a paper as a chapter in the CSIRO's book "Greenhouse 87"; the paper linked sea level rise to coastal erosion at 32 locations in NSW where his team had undertaken studies over the preceding decade. He has published a number of papers on climate change and was the lead author of the Engineers Australia 1991 guidelines for adaptation to climate change in the coastal zone.

For 9 years prior to his retirement he was General Manager of Pittwater Council. He is now free to indulge his passion for coastal zone issues such as adaptive coastal engineering solutions for an uncertain climatic future and is currently Chairman of the Industry Advisory Board to the University of NSW's Water Research Centre.





Douglas Rhodes

B.Rur.Sc. Office of Hawkesbury-Nepean, Manager Community Relations

Doug's career has included semi-arid land management, erosion and mining rehabilitation in Western NSW and Northern Tablelands of NSW, catchment management and a long-term involvement in water resource planning within the Sydney Basin.

The importance of interaction with the communities and the natural resource managers is a critical component in delivering a sustainable outcome within all these areas.



Colin Nicholson

Sydney Water

Colin has a BSc and honours degree in Civil Engineering from the University of Sydney plus post-graduate qualifications in public health engineering from UNSW.

He is currently the General Manager of Operations Division for Sydney Water Corporation. He manages the operation of Sydney 'Water's systems and processes including treatment plants, networks, telemetry and control systems and monitoring services. He also has teams providing specialist technical advice and managing energy supply, emergency management, security and the operational interface with regulators.



Bruce Coates

Principle Data Specialist (Coastal)

Department of Environment, Climate Change and Water.

Bruce has over 25 years experience in coastal and estuarine processes, coastal policy development, and coastal zone management. He has worked in a range of scientific and management roles in various NSW government agencies and held an adjunct position at the University of Sydney. He has a degree in marine science from the University of Sydney.

Bruce has previously been on the advisory board for the Centre for Research on Ecological Impacts of Coastal Cities and is currently on the NSW Council of the Australian Marine Science Association.





Will Strachan

BE (Hons), F.I.E. Aust., CPEng

Dept of Commerce

Will Strachan is a civil engineering graduate from the University of NSW (1972). Will leads NSW Water Solutions, a government business, which delivers expert services and solutions to the water, environmental and infrastructure sectors. NSW Water Solutions is a multi-disciplinary team of around 250 personnel of engineers, scientists, economists, technical and administrative personnel. This team of people undertakes in the order of 1000 projects during any one year; projects which involve: the investigation and design of dams, water supply and wastewater schemes and natural resources infrastructure. Manly Hydraulics Laboratory is also part of NSW Water Solutions.



Ian Tanner

**General Manager, Water Supply Division
Sydney Catchment Authority**

Graduated from UNSW in 1980 with a B.Sc (Eng.)

An outcome focused management professional combining technical, business, financial and interpersonal skills with 37 years of experience and achievements in the Water Industry. An experienced practitioner in the fields of: water and waste water systems investigations and design; construction management (including Project, Program and Contract management); operational management of catchments, dams, water supply systems, water filtration plants and sewage treatment plants; management of Engineering Services consultancy business; a Leader and Change agent.



Professor Graham Davies

BSc, PhD, DSc, CEng, FIET, FInstP, FIOM3, FREng

Graham Davies is the Dean of Engineering at the University of New South Wales, Sydney, Australia. He has held senior posts in academia at the University of Birmingham and corporately as director in charge of British Telecom's Corporate Research.





3) About WRC

3.1 Our Structure

The UNSW School of Civil and Environmental Engineering has a 60 year history of leading development of water technology in Australia. Apart from maintaining the largest postgraduate and undergraduate teaching programmes in water engineering in Australia, the School remains active in Australian fundamental water research:

Surface and groundwater hydrology - ongoing Australian leadership of the quantifying of rainfall, runoff and groundwater flows at catchment scales

Public health and water treatment - fundamental investigations of the chemistry and microbiology of water for urban use. We provide multidisciplinary research in water & wastewater engineering and the development of tools for environmental management & sustainability for improving the aquatic and atmospheric environments.

Civil and environmental hydraulics - practical project-based and theoretical hydraulics research. This research is undertaken using the unique large-scale facilities of the Water Research Laboratory at Manly Vale.

There are pressing contemporary needs for better-integrated water management at national and state levels in Australia. In recognition of present demand for more multi-faceted approaches to water management, in January 2008 the School has united its longstanding and major water research activities within a single water research centre.





Executive Committee

The following Executive Committee undertakes management of the Water Research Centre (WRC):

Associate Professor Richard Stuetz
Co-Director, WRC

Dr Bill Peirson
Co-Director, WRC

Prof David Waite
Head, School of Civil & Environmental Engineering

Dr Ian Turner
Deputy-Director (Research), Water Research Laboratory

Prof Ian Acworth
Connected Water Initiative, Water Research Laboratory

Assoc Prof Ashish Sharma
School of Civil & Environmental Engineering

Mr Brett Miller
Business Manager

Mr Robert Steel
Business Manager

This committee meets on a bimonthly basis to discuss strategy, performance and research opportunities within WRC.

3.2 Program Areas

Overview

The Water Research Centre is operated out of two locations – one at Kensington and the other, the Water Research Laboratory, at Manly Vale. Richard Stuetz and Bill Peirson jointly manage the centre.

The new centre activities are grouped into three dominant research themes:

1. Water Supply

Australia is a continent of low rainfall and its development and economic robustness is constrained by presently available and potential water supplies.

Management Committee

As required for all UNSW Centres, a Management Committee for WRC, was established by the Vice-Chancellor, on advice from the Pro-Vice-Chancellor (Research) and the Dean of Engineering. This Management Committee is responsible to the Vice-Chancellor for ensuring the objectives of the Centre are pursued and the terms of reference of the Centre are implemented. During 2008 the Management Committee for WRC was made up of the following members:

Prof Dianne Wiley
Acting Dean, Faculty of Engineering (Chair)

Prof David Waite
Head, School of Civil & Environmental Engineering

Assoc Prof Richard Stuetz
Co-Director, WRC

Dr Bill Peirson
Co-Director, WRC

Prof Jason Middleton
Department of Aviation, Faculty of Science

Prof Staffan Kjelleberg
School of Biotechnology and Biomolecular Sciences, Faculty of Science

Associate Prof Laura Poole-Warren
Associate Dean (Research), Faculty of Engineering

2. The Coast

Over 86% of the Australian community live in the coastal zone with consequent environmental impact and climate vulnerabilities.

3. Sustainability

To maintain Australia's current level of population and economic growth, water and contamination management need innovative solutions in terms of environmental, energy and social considerations.





4) Highlights for 2008

4.1 Awards & Honours

Stuart Khan – National Water Commission Fellowship

Dr Stuart Khan was awarded an inaugural Fellowship from the National Water Commission. The purpose of the Fellowship is to investigate a series of advanced techniques for quantitative chemical exposure assessment of water recycling schemes.



Dr Anne Roiko (University of the Sunshine Coast) & Dr Stuart Khan (UNSW)

The Fellowship will produce a peer-reviewed handbook describing practical methods for quantitative assessment of exposure to chemical and microbial contaminants from recycled water systems and will take a few years to complete. The handbook will address the key issues of treatment performance variability and system reliability. It will cover both potable and non-potable water recycling schemes. The format of the handbook will be such that a wide spectrum of water utilities and consultants can immediately implemented the findings. The handbook will complement and build-on risk assessment approaches described in recently developed National Guidelines for Water Recycling.

Ron Cox – Civil Engineer of the year

Engineers Australia’s prestigious Sir John Holland Award for Civil Engineer of the Year 2008 was presented to Associate Professor Ron Cox in recognition of his long standing and continuing contribution to the profession and community, particularly in the field of coastal engineering.

The Civil College of Engineers Australia presents this prestigious award annually to an eminent civil engineer considered to have made a major contribution to the profession.

Ron has been associated with UNSW’s Water Research Laboratory since 1973 and held senior positions for more than half of his 34 years. He was Director from 1993 to 2006 and prior to that, he was Projects Manager.

As a practicing coastal engineer, leader of Australia’s foremost coastal engineering organisation, and as an inspirational academic, Ron has led research, investigation and design teams for projects in every state and territory in Australia and in many countries around the world.

During his time on Engineers Australia’s National Committee on Coastal Engineering - including his four years as President - Ron was in the forefront of development of coastal engineering response to climate change. He co-authored several important Engineers Australia publications such as Guidelines for Working with the Coast in an Ecologically Sustainable Way, and Guidelines for Responding to the Effects of Climate Change in Coastal and Ocean Engineering. He is now National Convenor for the Federal Government funded Australian Climate Change Adaptation Network for Settlements and Infrastructure based in the School of Civil and environmental Engineering at UNSW.





Dr William Glamore – PIANC’s De Paepe, Willems Award

Dr William Glamore was awarded PIANC’s De Paepe - Willems Award for excellence in Coastal, Marine and Inland Waterways. PIANC, the world’s premier association related to international navigation and waterway issues, bestows the De Paepe - Willems Award to celebrate excellence in the fields of waterway management and engineering.

An international committee recognised William’s journal paper “Decision Support Tool for Assessing the Impact of a Boat Wake Waves on Inland Waterways” as deserving of the prestigious award.

In recognition of the award, William gave the keynote address at PIANC’s 2008 Annual General Assembly in Beijing, China in late May 2008. He also had his paper published in PIANC’s journal “On Course”, granted membership to PIANC for 5 years and was awarded a cash prize of €5,000. William was eligible to win the award after receiving PIANC’s author award at the 2007 Coast and Port’s Conference in Melbourne.



The Decision Support Tool outlined in William’s paper provided an objective methodology to determine the impact of boat generated waves along a stretch of waterway, and was developed through multiple commercial projects funded by the NSW Maritime Authority. William is the first recipient of the award from a country outside of the EU or USA.

Jacque Thomas – American Australian Association Fellowship.

Ms Thomas was awarded an American Australian Association fellowship by the Prime Minister and Mr Rupert Murdoch. The fellowship will enable her to travel to the United States in 2009-2010 to undertake a portion of her doctoral research with Professor Nicholas Ashbolt, previously a Professor at UNSW and now at the United States Environmental Protection Agency.



**From left to right: Mr Malcolm Binks (Chairman for the American Australian Association); Prime Minister Mr Kevin Rudd; Mr Rupert Murdoch and Jacquie Thomas.
(PHOTO CREDIT - Lisa Hogen Photography)**

Ms Thomas is a UNSW microbiology graduate and her PhD research is contributing a significant piece of knowledge to our understanding of reuse water. Specifically, she is looking at the ability of the bacterial pathogen *Legionella* to grow in reuse water. *Legionella* infection causes pneumonia and accounts for 3-5% of all pneumonia admissions to hospital in Australia. In water systems, *Legionella* growth is facilitated by the presence of common water microbes called amoebae. As reuse water is used more extensively, it is essential that all the risks factors for the growth of *Legionella* and other

disease causing microorganisms be identified. Through identification and reduction of the risk factors, the safety of reuse water can be assured.

Ms Thomas’s research has been undertaken as part of a collaboration between the UNSW Water Research Centre, Sydney Water Corporation and researchers at the United States Environmental Protection Agency.





4.2 Staff Focus

During the year we have welcomed many new staff to our team. Here we profile a few of those staff.

Matt McCabe

Dr McCabe received his Engineering and PhD degrees from the University of Newcastle, Australia. He started in the WRC in January 2008 as a Senior Lecturer in the School of Civil and Environmental Engineering.

Prior to this appointment he worked in the USA for 5 years, as a research scientist at both Princeton University and more recently at Los Alamos National Laboratory. His research interests focus around land surface hydrology - particularly in the use of satellite remote sensing to characterise water and energy cycles within the Earth system. Incorporating this information into modelling approaches to improve understanding of water and energy cycle behaviour remains a primary research interest.

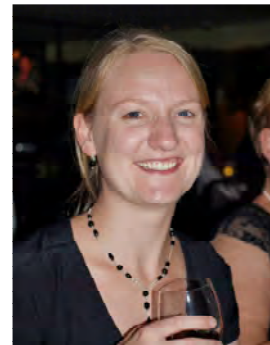


Apart from space based satellite applications, Dr McCabe is also involved in utilizing novel in-situ based measurement approaches for increasing process understanding, especially in the areas of stable water isotopes, land surface fluxes and soil moisture estimation techniques. He is a member of the World Climate Research Programme GEWEX Radiation Panel, a Guest Professor at the Chinese Academy of Sciences, a Visiting Scientist at Los Alamos National Laboratory and a Chief Investigator on the recently announced \$30M National Centre for Groundwater Research and Training, where he is pursuing interests in groundwater-vegetation-atmosphere interactions.

Rita Henderson

Rita started her career in Edinburgh studying undergraduate chemistry. Then, having worked as an environmental consultant for a year, she became involved in the area of water research after signing up for an MSc in Water Treatment Control Technology at Cranfield University, UK. During her 4 years there, she completed a PhD in the optimisation of drinking water treatment processes for algae removal, which remains a major research interest of hers.

On completion of her PhD in 2007, she was tempted “down under” with tales of sunshine, sand and surfing, along with a post doc investigating the use of fluorescence as a sensitive method for detecting failures in recycled water treatment and distribution systems. Currently Rita’s research interests lie in the optimisation and monitoring of drinking water treatment processes and distribution systems, particularly with respect to removing algae and organic matter. Rita is an active member of the International Water Association where she sits on the Young Water Professionals committee.





Chris Blenkinsopp



Chris completed his degree in Civil Engineering at the University of Nottingham, UK. After graduating, he worked part-time for ASR Ltd, a New Zealand-based Marine Consultancy while completing a PhD in Coastal Hydrodynamics at the University of Southampton. During his time with ASR, he completed a wide range of Coastal Engineering consultancy studies and was involved in pioneering research into artificial surfing reefs and assisted with the design of reefs in New Zealand, Australia, UK, USA, Costa Rica and India.

Chris joined the UNSW Water Research Laboratory in 2007 as a Postdoctoral Research Associate on an ARC Discovery Project investigating wave-by-wave bed-level changes at the beachface of gravel and sand beaches. As part of this project, Chris has been involved in a series of large multi-institutional field experiments in France, England and the Netherlands, the results of which have provided important new insights into the highly dynamic nature of beach erosion and accretion.

In addition to his work on the ARC Discovery Project, Chris is interested in a wide range of coastal and fluid problems including breaking waves and air entrainment processes and is currently investigating the application of LiDAR technology for making measurements of nearshore coastal processes such as the reshaping of breakwaters and the morphological response of beaches during storms.

Conrad Wasko

Conrad Wasko is a Project Engineer at the University of New South Wales' Water Research Laboratory (WRL). Prior to starting his graduate employment at WRL, he completed a Bachelor of Civil Engineering and a Bachelor of Science in Statistics at the University of New South Wales. During these undergraduate studies he undertook several research scholarships including analysis of the impact of antecedent conditions on flood modelling using SWMM, and investigating the impact that solar variability has in precipitation patterns. This latter research was published in the journal Geophysical Research Letters. Conrad graduated from the University of New South Wales with both First Class Honours and a University Medal in 2007.

Since joining the Water Research Laboratory in 2008, Conrad has worked in a wide range of areas including flood inundation modelling using MIKE Flood, hydraulic modelling using MIKE-11, and hydrodynamic and water quality modelling using the RMA modelling suite. He has also worked on numerical modelling projects in groundwater using FEFLOW, and modelling outfall hydraulics. Conrad is currently furthering his studies by undertaking a Masters of Engineering Science.





4.3) Research initiatives

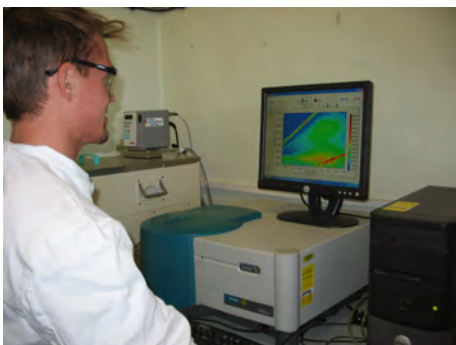
2008 was another outstanding year for WRC in terms of significant research initiatives. In this section we highlight some of these research projects.

Fluorescence as a tool for sensitive detection of failures in recycled water treatment and distribution systems

Water reuse is emerging as a key strategy for the conservation of drinking water supplies around Australia. Public health protection from contaminants in recycled water is of paramount concern to water authorities. Accordingly, there is a need for a fast, reliable, affordable, and highly sensitive means of ensuring reliability of treatment processes and final water quality. Hence, the aim of the proposed research is to develop a means for rapid and sensitive monitoring of water quality in recycled water treatment and distribution systems. It is anticipated that characteristic fluorescence excitation-emission spectra of dissolved organic matter in treated wastewater will provide the most suitable indicator conforming to these criteria. The intended outcomes include a technique that can be used for online monitoring for underperformance or failure of treatment processes such as reverse osmosis and as a portable system for rapid identification of cross-connections between potable and recycled water supplies. Such outcomes will have significant implications in terms of public health, environmental protection, and public confidence in the integrity of recycled water practices. This research is expected to take three to four years to complete.



Sachin Singh collecting samples



**Adam Hambly and
fluorescence**

The chief investigators on this research are Dr Stuart Khan and Prof Richard Stuetz both from the UNSW Water Research Centre. Other members of the project include Professor Andy Baker, Dr Michael Storey, Dr Rita Henderson and Dr Kate Murphy. The PhD students on this research are Mr. Adam Hambly and Mr. Sachin Singh.

The ARC awarded a linkage grant to this project and industry partners included Sydney Water Corporation, Melbourne Water, Sydney Olympic Park Authority, Gold Coast City Council (Gold Coast Water), South East Water Limited, City West Water Limited, Yarra Valley Water Limited and Water Corporation.





The Sustainability Covenant between EPA Victoria and the Sustainability Assessment Program at the UNSW Water Research Centre

The goal of the three year Sustainability Covenant between the Environmental Protection Authority (EPA) Victoria and the Sustainability Assessment Program at the UNSW Water Research Centre is to develop a strategy to support lifecycle science at EPA and guide the future development and integration of sustainable decision-support tools within EPA activities. The Sustainability Assessment Program has been working to enhance methodologies for sustainability assessment of products, processes and policies, and seeks to extend the application of these methodologies to both industry and governmental sectors.

With its mission to 'protect, care and improve the environment', EPA Victoria aims to enhance its regulatory policies and processes by informing them with the latest ideas from research and development through the application of life cycle management (LCM). With the aim of demonstrating itself as a leader in LCM, EPA Victoria wants to be active in developing and applying quantitative analytical tools including life cycle assessment (LCA), life cycle costing (LCC) and risk assessment (RA) and broader sustainable decision-making frameworks. By increasing its practical engagement with these types of analyses and frameworks and by maintaining an appropriate regime of internal training and acquisition of external skills, EPA will demonstrate a relatively unique ability to deliver sustainability science outcomes.

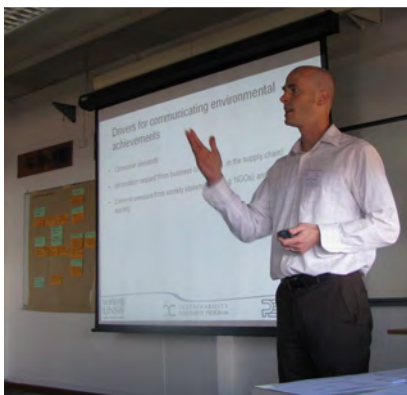
The Sustainability Covenant started in January 2008 and is expected to last many years.

The main activities during 2008 of the Sustainability Covenant included an audit of current decision-making processes across different areas of EPA, a comparison of the state of development and application of some important life cycle approaches and decision-support tools, their application to different case studies and EPA's internal and external organisational capacity to apply sustainability decision-support tools to EPA activities.

The focus of year two of the Sustainability Covenant will be on the development of a sustainable decision framework (SDF). As a first step, a literature review outlined the scientific basis for the different elements that comprise a SDF and identified common features and main differences between frameworks recommended and/or used today. Based on these insights and after selecting a suitable case study application area for such a framework within EPA, the project team developed a draft SDF that could be applied to the management of contaminated groundwater remediation.

The following years of the Sustainability Covenant will focus on trialling, adapting and refining this SDF so that it can become part of official EPA decision-making processes. The Sustainability Assessment Program at the UNSW Water Research Centre will also support EPA Victoria in the development of new services (e.g. life cycle mapping), run training courses and workshops facilitating the application of sustainability assessment tools and help position EPA Victoria as a leader in the field of LCM with an up-coming ARC research project which seeks to develop a more thorough sustainability assessment tool by integrating aspects of LCA and environmental RA methodologies.

The main people involved in this Covenant are Sean Shiels and Sally Jungwirth from EPA Victoria and Matthias Schulz, Michael Short and Greg Peters from UNSW. It is considered likely that this fruitful life cycle science partnership between the two organisations will continue beyond the original three-year timeline of this Sustainability Covenant.



**Matthias Schulz
Facilitating a LCM
workshop**



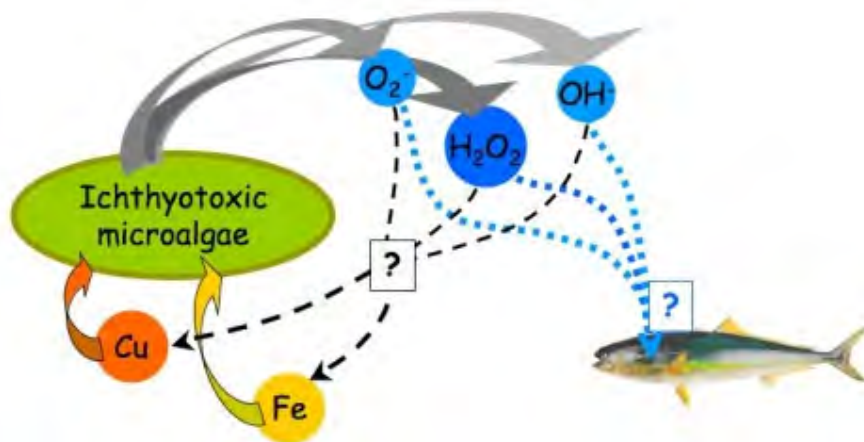


Impact of Reactive Oxygen Species on the Toxicity of Marine Algae in Australian Coastal Waters

The occurrence of harmful algal blooms is increasing worldwide with consequent economic loss, irreparable damage to aquatic ecosystems and potential human health impacts. Occurrence of blooms have resulted in; serious damage to fish farming in Japan, tuna mortality events in South Australia, damage to the Tasmanian salmon industry, a markedly decrease fish populations in coastal waters of Moreton Bay and the Great Barrier Reef, Hawaii and Florida, as well as potentially inducing the formation of tumours in green turtles and dugongs.

Despite the huge detrimental impact, limited progress has been made in understanding either the factors controlling the occurrence of these organisms or the modes of toxicity. While a variety of apparently toxic organic compounds are released to the external environment by these organisms, the only consistent observation is that many of them are particularly effective producers of the radical anion and reactive oxygen species (ROS), superoxide. Although they are not the sole ichthyotoxic principal, it appears that superoxide may enhance the toxicity of algal exudates, and as such, ROS have been compared to 'molecular blow torches' that invoke cell damage and aid delivery of algal toxins to their targets.

Recent studies suggest that the interplay between delivery of the nutrient trace metals iron and copper and the method via which the organism acts to assimilate these metals is critical to the generation and aggressiveness of the toxins produced. These metals may be instrumental, via Fenton-like chemical and photochemical processes, in generation of free radicals which, in turn, are associated with the toxic nature of exudates.



As such, this project aims to elucidate the role that interactions between redox active metals (particularly iron and copper) and reactive oxygen species (including superoxide, hydrogen peroxide and hydroxyl radicals) play in both the growth and highly variable toxicity of selected Australian harmful microalgae in coastal and estuarine waters.

The information so obtained is expected to be critical in understanding the impact of terrestrial inputs (as influenced by catchment management practices and/or rainfall patterns) on both the growth and toxicity of potentially harmful algal blooms in the coastal environment and, thus, of the potential to minimize economic, environmental and human health impacts through improved management.

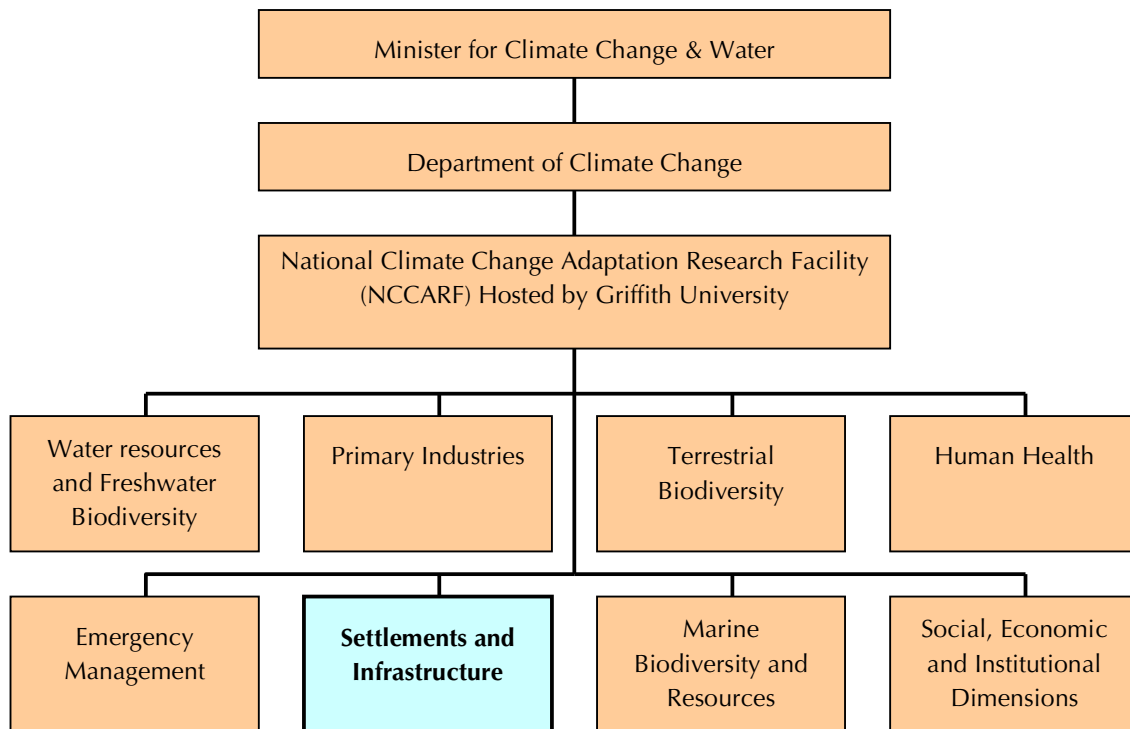
The Project Team comprised of Aurelie Giboureau Godrant, Shikha Garg & T. David Waite (UNSW WRC), with Andrew Rose (UNSW WRC) and Gustaaf Hallegraeff and Juan Dorantes-Aranda (University of Tasmania). This is an ARC Discovery funded project.





The Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (ACCARNSI)

In 2008 the Australian Government committed funding of \$10 million over four years to establish eight national research networks investigating the effects of climate change on areas such as water resources and freshwater biodiversity; primary industries; terrestrial biodiversity; human health; emergency management; settlements and infrastructure; marine biodiversity and resources; social, economic and institutional dimensions. Griffith University is the overall manager of these eight research networks.



The *Settlements and Infrastructure Network* or “The Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (ACCARNSI)” is based in the UNSW School of Civil and Environmental Engineering. The School’s Associate Professor Ron Cox, is Convener of the National Network for Settlements & Infrastructure which aims to lead the research community in a national interdisciplinary effort to generate the information needed by decision-makers in government and in vulnerable sectors and communities to manage the risks of climate change impacts and choose appropriate adaptation strategies.

Nine out of ten Australians live within 50kms of the coast and the Network for Settlements and Infrastructure will be focusing on the impacts of climate change on coastal settlements, public and private infrastructure – including building and facility design and construction - urban water security, flooding and storm water overflow. The Network will also be fully exploring the social, economic, and institutional implications of climate change impacts, and the resulting implications for planning, design, and management of Australian settlements and infrastructure.

The Network provides a groundbreaking opportunity to bring together scholars and stakeholders who, hitherto, have largely operated in isolation. Their shared knowledge and expertise will be brought to bear in

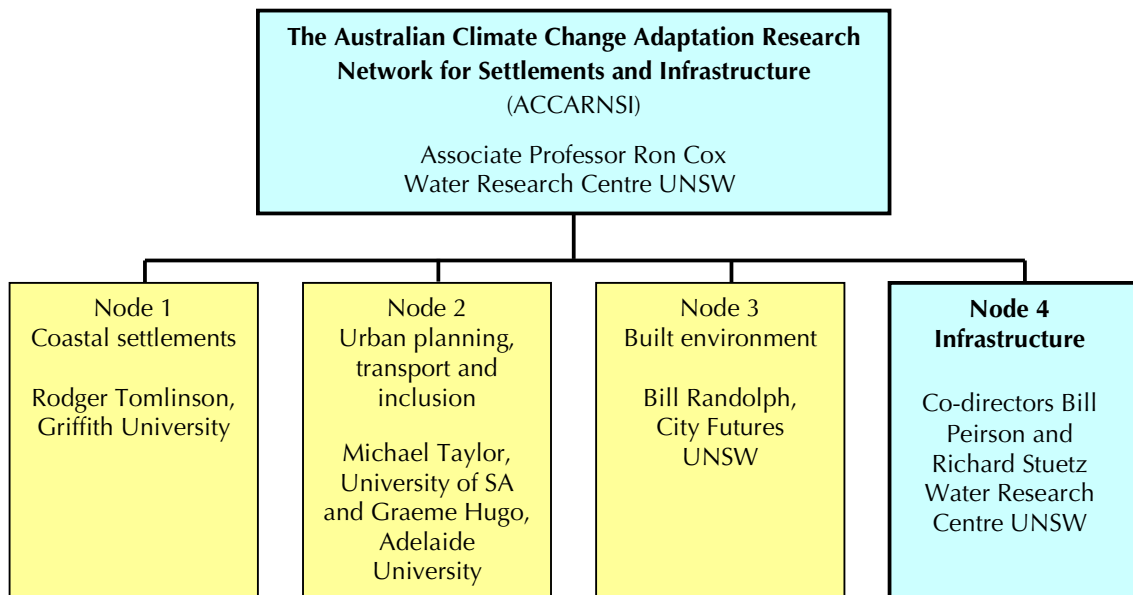




assessing the vulnerabilities of Australia’s settlements, infrastructure, and built environment and developing adaptation responses to predicted climate change.

The Network incorporates broad engineering based research and information networks established through the various committees and panels of Engineers Australia, and the existing Australian Sustainable Cities and Regions Network which is leading research in urban planning and the built environment. The aim is to make research into climate change adaptation in both the physical and human aspects of Australia’s settlements and infrastructure a truly multi-disciplinary enterprise. In this way, the Network will build our understanding and national adaptive capacity and reduce our vulnerability to climate change in key sections and regions of the country.

The ACCARNSI Network is divided into four nodes as follows:



Infrastructure

Node 4: Infrastructure is based in the Water Research Centre, co-directed by Bill Peirson and Richard Stuetz. This group aims to address the prominent infrastructure issues related to energy, water security, stormwater and flooding, transport, communications and broader engineering infrastructure.

Richard Stuetz working in collaboration with Justin Brookes of Adelaide University’s Institute for Climate Change and Sustainability will lead in exploration of adaptation technology and management to ensure water security in face of climate change – encompassing improved and sustainable water and wastewater services including potable water and wastewater technology in cities and settlements. This research-network partnership will work with water utilities in setting the planning and the priority needs through the Water Association of Australia and Water Quality Research Australia.

Bill Peirson will lead the network members in considerations related to energy, flooding and stormwater adaptation. Reduced average rainfall coupled with more intense extreme storm events and rising sea levels require the development of innovative adaptive responses in stormwater infrastructure and flood plain management.

Website: <http://www.nccarf.edu.au/settlements-infrastructure/>





Sea Level Rise and Coastal Hazard Assessment for Clarence City Council, Tasmania

In 2007 the Water Research Laboratory had commenced a detailed sea level rise and coastal hazard assessment for Clarence City Council, Tasmania. This project was jointly funded by Clarence City Council, Tasmanian State Government, and the Australian Government Department of Climate Change; and is intended to be a pilot project for future sea level rise assessments nation wide.

This council wide coastal vulnerability assessment is one of the largest and most detailed studies undertaken in Australia to consider local coastal processes and sea level rise implications. The methodology adopted by WRL for this investigation is now considered a best practice framework for local sea level rise investigation.

To quantify the impacts of sea level rise and the vulnerability of assets and coastal land, a large range of coastal processes were considered in the investigation including tides, storm surge, extreme ocean waves and swell wave penetration, wind waves, and long-shore and cross-shore sand transport.

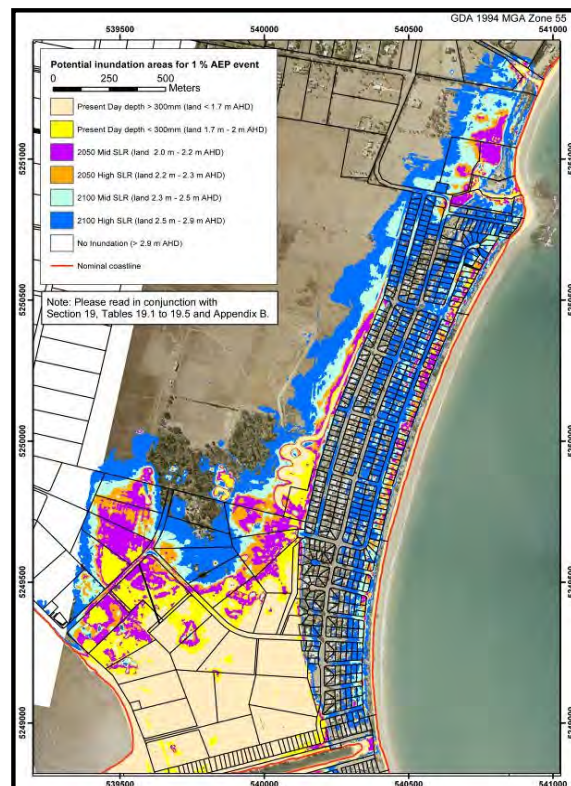
The effect of sea level rise on hazards such as beach erosion and recession, estuary entrance stability, wind blown sand and inundation, was considered in detail as a part of the investigation. These processes and hazards were considered on a detailed level that allowed quantification of sea level rise implications on specific beaches, headlands, and embayment; as well as assets such as roads, buildings, and stormwater infrastructure. Appropriate adaptive planning management strategies were presented as a part of this investigation.

WRL worked with SGS Economics and Planning, to assess the economics and feasibility of a range of adaptive management options for specific beaches throughout Clarence City Council. One of the adaptation strategies considered, was initial and ongoing beach nourishment with estimation of required sand quantities and costs, the future sand demand, and the cost/benefit of undertaking beach nourishment as an adaptation strategy for the beaches.

In undertaking this project, WRL demonstrated extensive expertise and understanding of contemporary climate change science, and implications of sea level rise on coastal processes and hazards.

WRL's long history and experience in coastal process analysis were combined with current day sea level rise predictions to investigate the vulnerability of Clarence City Council's coastal assets, and possible adaptation strategies.

Due to a lack of appropriate policies and procedures for coastal hazard assessment in Tasmania, WRL was able to use its extensive knowledge of policies and practice from other states to implement best practice for Clarence City Council.



Hazard lines and inundation areas overlain on digital cadastral map





Physical Modelling of Geotextile Breakwaters, Abu Dhabi

WRL was commissioned by International Coastal Management (ICM) during 2008 to undertake two and three dimensional physical modelling of a range of coastal management schemes, which were proposed for the shoreline of an island development in Abu Dhabi. The proposed coastal development scheme consisted of a field of low crested geotextile container breakwaters, utilised in combination with beach nourishment.

This investigation included 2D flume testing at a scale of 1:25 investigating wave transmission, wave runup, and overtopping for a range of breakwater designs and recurrence interval events. The 3D wave basin modelling at a scale of 1:40 was primarily undertaken to measure nearshore wave driven currents, as well as transmitted wave conditions.



(Clockwise) Model construction – wave basin; Completed model before testing; Dye tracer testing - wave basin; Overtopping testing - wave basin





Tomago Wetland Remote Monitoring



WRL website image gallery; Installing camera on 18 m tall pole

The Water Research Laboratory is working with the NSW Department of Climate Change (National Parks and Wildlife Services (NPWS)), to examine how coastal wetlands evolve following tidal restoration. Dr William Glamore of WRL has been working with NPWS staff to restore Tomago Wetlands (part of the Kooragang Wetland Ramsar Site) since 2005. At this site SmartGates were developed and installed to allow for controlled tidal exchange. Following a series of field trials and on-ground works the SmartGates were opened to full tidal flushing in September 2008.

Monitoring of the restored site involves field sampling of surface and groundwater quality, biological monitoring of flora types and routine bird monitoring. To further monitor the long-term evolution of the site and allow for offsite management, a digital camera was installed atop an 18 m tall pole.

The camera is in a fixed position and currently takes images 5 times per day. These images are then sent to the WRL servers via the 3G network and displayed on the WRL website for viewing and archiving.

The images are currently being used for several purposes, these include:

- Assessing the coverage of tidal water with time
- Determining the hydroperiod and related plant species
- Determining how the dendritic channel network evolves with time
- Assessing the type and quantity of birds onsite throughout the day
- Determining the impact of large rainfall events on the site and drainage patterns
- Assessing whether the SmartGates should be operated based on real-time onsite conditions
- Reducing vandalism onsite
- Calculating the evolution of saltmarsh using red shift filters
- Determining if cattle or other unwanted species are gaining access to the site

Additional images can be taken as required throughout the day. The camera can also be rotated at preset times to take images in alternative locations. Onsite field measurements of discharge and water level are being used in conjunction with the camera to determine the flux of key surface water quality constituents.

Further information can be obtained from Dr William Glamore at: w.glamore@wrl.unsw.edu.au or (02) 8071 9868.





Largest Beach Instrument in the world

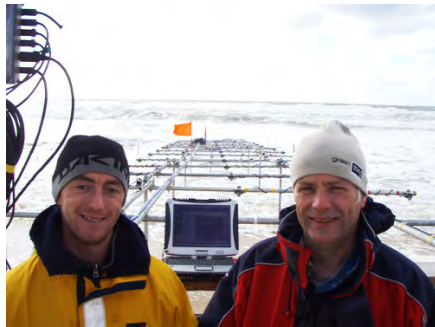
An exciting large international beach research effort was undertaken during 2008 in South West France, by researchers from the UNSW Water Research Centre, working alongside partner investigators from the University of Plymouth, Bordeaux University, and the French Navy. Dr Ian Turner, Deputy Director (Research) of the Water Research Laboratory, accompanied by post doctorate Dr Chris Blenkinsopp, led the UNSW team.

As part of this research, an instrument array was deployed, consisting of a 1.5 tonne, 30 m x 4 m scaffold structure across the beach from which a total of over 89 individual sensors were mounted to measure a range of parameters; including flow velocities, fluid turbulence, water levels, suspended sediment concentrations and beach levels. Requiring 5 computers running simultaneously to control and log the data being generated, the construction withstood 5 m high storm waves – the largest storm in the region for the past 10 years.

The UNSW contribution in this collaborative research was to measure the quantity of sand lifted from, and deposited across, the beachface with every wave. To achieve this, the team spent two years developing an array of 45 bed-level sensors that measure changes in sand elevation to an accuracy of around 1 mm, or the height of just 2 - 3 sand grains. Based upon the principle of the detection of reflected ultrasonic sound waves, the sensors are deployed across the beachface in a dense grid, and programmed to take measurements at the rate of 4 times every second.

This novel research revealed intriguing and unexpected results. Bed-level changes of up to 20 mm were recorded by single waves, equating to erosion and deposition of 100's of kilograms of sediment. The fundamental fluid-sediment mechanisms that control these rates (and direction) of sediment movement are currently being analysed, the next challenge for the combined UNSW/UoP team is to begin to numerically model and ultimately predict rates of resulting erosion-accretion at the coastline.

This research is being jointly funded by the Australian Research Council (Discovery) and the UK Natural Environment Research Council.



Dr Chris Blenkinsopp (left) and Dr Ian Turner (right) standing beside instrument rig



Largest beach instrument in the world

Truc Vert SW France



5) Research Grants for 2008

Key Researchers	Research Topic	Granting Organisation
I Acworth	Development of surface-groundwater and hydrological data research facilities at Wellington and UNSW	NSW Science Leveraging Fund
I Acworth	Infrastructure for groundwater research	Australian Federal Department of Innovation, Industry, Science and Research
I Acworth, M Andersen	Development of heat tracer techniques for determining surface-groundwater connectivity	National Water Commission and Cotton Development and Research Corporation
I Acworth, M Andersen, W Timms M McCabe	National Centre for Groundwater Research and Training	Australian Research Council and National Water Commission
I Acworth, B Kelly (Science), M Andersen, B Giambastiani (Science), A Greve, A McCallum	Surface- and groundwater connectivity in Maules Creek	Cotton Catchment Communities CRC
Martin Andersen, Funding secured in collaboration with Professor Ian Acworth	Quantify surface water groundwater exchange using thermal and chemical measurements.	National Program for Sustainable Irrigation, Land & Water Australia
N. Ashbolt	Pathogen risk indicators for wastewaters and biosolids	WERF through CRCWQT
N. Ashbolt D. Roser S. Petterson	Application of microbial risk assessment techniques to estimate risk due to exposure to reclaimed water.	Water Reuse Foundation
N. Ashbolt, C. Davies, C. Kaucner	Riparian and water quality protection by influencing livestock movements.	Sydney Catchment Authority
N. Ashbolt, D. Roser, C. Davies, S. Petterson	Estimating the Relative Risk from Sewage Treatment Plant Effluent	Sydney Catchment Authority
N.J. Ashbolt, S. Lundie	Development of an integrated sustainability framework for best management practice of urban water systems	ARC, Total Environment Centre, WSAA
N. Ashbolt, G. Peters, D. Roser, S. Khan, C. Davies	Managing the contaminants in feedlot waste products (Flot 333)	Meat and Livestock Australia Ltd
Michael Banner (UNSW Mathematics), Bill Peirson, Frederic Dias (ENS Cachan, France)	Forecasting wave breaking in directional seas	Australian Research Council – Discovery



Key Researchers	Research Topic	Granting Organisation
James Carley, Ron Cox, Ian Turner, Doug Anderson, William Glamore, Bill Peirson	Coastal engineering and management	Clarence City Council, Parsons Brinckerhoff, Warringah Council, Byron Shire Council, Australian Fresh Corp., MTK Consulting, Pitt & Sherry, Glenorchy City Council, NSW Department Of Primary Industries, Dept Of Sustainability & Environment Victoria, NSW Department Of Lands
James Carley, Ron Cox, William Glamore, Brett Miller,	Coastal structures and wave protection	Cardno Lawson Treloar, Delta Marine Consultants, Water Technology, Tonkin & Talyor, Leighton Contractors, Oceanlinx, Kellogg JV, Maunsell Australia, International Coastal Management
David Carmichael, Dr M. C. A. Balatbat (ASB, UNSW), A/Prof R. L. Tiong (NTU, Singapore)	"Role of Carbon Financing in Developing Nations in Mitigating GHG Emissions",	Contestable Funding for International Strategic Projects, UNSW
R. Collins		ANSTO
William Glamore, Brett Miller	Environmental restoration studies	Hunter-Central Rivers CMA, NSW Maritime Authority, Dept. Of Environment, Water, Heritage & Art, NSW Dept Of Environment & Climate Change, NSW Department Of Primary Industries
William Glamore, Brett Miller, Bill Peirson	Water resources, sedimentation & environmental flows	URS, Engineers Australia, Charles Darwin University
S. Khan	The use of chiral pharmaceutical compounds to characterise sewage treatment processes and sewage contamination of surface waters	ARC
S.Khan	Development of and "Ecotoxicity Toolbox" to evaluate Water Quality for Recycling - Part Two	Department of Water Western Australia
S.Khan	National Water Commission Fellowship: Quantitative Contaminant Assessment for Water Recycling Schemes	NWC
S. Khan	Participation in ACTEW bid with Laing O'Rourke	Laing O'Rourke Constructions Pty Ltd
S. Khan	Replacement Flows Project	Sydney Water through UNSWGlobal - originated at CWWT
S. Khan	Analytical services	Sydney Water
S. Khan R.Stuetz A. Baker M.Storey	Fluorescence as a tool for sensitive detection of failures in recycled water treatment and distribution systems	ARC Linkage Project
S. Lundie A. Feitz G. Peters	Life Cycle Analysis of the grass fed red meat industry	Meat and Livestock Australia Ltd
J. McDonald	ECR/FRG Grant	UNSW/Engineering
Brett Miller; Ron Cox, James Carley	Harbours and sheltered waterways	P D Naidoo & Associates, Australian National Maritime Museum





Key Researchers	Research Topic	Granting Organisation
Brett Miller, William Glamore, Wendy Timms, Bill Peirson	Desalination intakes and outfall design for minimising environmental impacts	Sydney Water Corporation, John Holland, Pall Australia, GHD, Blue Water JV
Brett Miller, William Glamore, Bill Peirson, Bruce Cathers	Sewage disposal in coastal waters and environmental impacts	United Group Infrastructure, NSW Department Of Commerce, Sydney Water Corporation, Hunter Water Corporation, Gunns Ltd
Brett Miller, William Glamore, Bill Peirson, Bruce Cathers	Estuarine water quality and environmental flows	Dept. Nat Resources Environment & Arts, MidCoast Water
Brett Miller, James Carley, Bill Peirson, Bruce Cathers	Hydraulics of power generation	Outotec, Oceanlinx
Brett Miller, Ron Cox, Bill Peirson, Doug Anderson	Flood modelling and floodplain management	Penrith Lakes Development Corp., SMEC
Brett Miller, Ron Cox, Bruce Cathers, Bill Peirson	Water/wastewater hydraulics and turbomachinery performance	Launceston City Council, Expella, Worley Parsons, Bluescope Steel
Brett Miller, Bill Peirson, Bruce Cathers	Stormwater and pollution control	Stramit Building Products, Rio Tinto Alcan, Cardno CCS, Ergon Energy, United Group Infrastructure
Stephen Moore	Collaboration with National Taiwan University	Australian Academy of Science
G. Peters	Creating an environmental sustainability assessment tool (ESAT)	Smart Water Fund
G.Peters	Sustainability covenant	EPA Victoria
G.Peters	Eco-footprinting	EPA Victoria
G.Peters	Peer Review	URS Australia Pty Limited
G. Peters M. Schulz	Quantification of embodied greenhouse gas emissions for chemicals to be used in the proposed Adelaide Desalination Plant	S.A. Water
G. Peters	Seventh Framework Programme Marie Curie Actions- People - International Research Staff Exchange Scheme - ECOTOOL	European Commission
D. Roser	Premiers Water Fund- University of Western Australia - Assessing the Public Health Impacts of Recycled Water Use. Subcontract to UWA	UWA/PWF
D. Roser	Investigations into Public Swimming Pool Contamination by the Opportunistic Pathogen Pseudomonas aeruginosa - Situation Review Phase	Sydney City Council through UNSW Global - originated at CWWT
D. Roser	Design of the Burwood Beach Wastewater Treatment Plant Health Risk Assessment: Stage 1 - Design of Methodology for Quantitative Microbial Risk Assessment	Hunter Water Corporation
D.Roser	Qatar Electricity and Water Commission Assistance in the development of drinking water quality management systems for desalinated water	GHD through UNSWGobal - originated at CWWT





Key Researchers	Research Topic	Granting Organisation
D. Roser W. Glamore	Burwood Beach WWTW Health Risk Assessment	Hunter Water Corporation
A. Sharma	Climate change and its impacts on water supply and demand in Sydney	The Cabinet Office (NSW)
R. Stuetz	ARC LIEF Grant LE0883080 - Detection of Trace Concentrations of Chemical Contaminants in Urban Water Systems	ARC, UQ, UTS, UNSW
R. Stuetz	Quantification and evaluation of odorants from poultry sheds.	Australian Poultry CRC
R. Stuetz G. Parcsi	PhD Scholarship	Australian Poultry CRC
R. Stuetz S. Dever	Passive drainage and biofiltration of landfill gas using recycled materials	NSW Dept of Environment & Conservation
R. Stuetz	Optimal Management of Corrosion and Odour Problems in Sewer Systems	ARC Linkage Project through U.Q
R. Stuetz N Ashbolt S Khan	Removal of potential impact of pharmaceutical active compounds during waste water treatment (DP558029)	ARC Discovery
G. Swarbrick R. Stuetz S. Dever (PGH)	Former Camide landfill, Horsley Park: Landfill gas drainage & biofiltration trial	CSR PGH
Wendy Timms, William Glamore, Doug Anderson, Ian Acworth, Ian Turner	Groundwater studies related to effluent disposal	NSW Department Of Commerce, Kempsey Shire Council
Wendy Timms, Brett Miller, William Glamore, Doug Anderson, Ian Acworth, Ian Turner	Groundwater studies, supply, monitoring, salinity and pollutant transport	Orica Australia, NSW Dept Of Primary Industries, Caroon Coal Project, Sydney Coastal Councils Group, EWL Sciences, Cotton Catchment Communities CRC
Ian Turner, G Masselink (UK) PR Russell (UK)	Wave-by-wave bed level changes at the beach face of sand and gravel beaches.	Australian Research Council – Discovery
Ian Turner, AD Short, University of Sydney, R Ranasinghe, NSW DECC	Investigating large-scale climatic control of coastal erosion and shoreline changes using a unique long-term data set and innovative video monitoring technology.	Australian Research Council – Linkage
Ian Turner G Masselink (UK) PR Russell (UK)	Beach change over individual wave cycles on sand and gravel beaches.	UK Natural Environment Research Council
Ian Turner	Development of video-based techniques for real-time monitoring and analysis for coastal engineering and coastal management.)	NSW DECC and LQD EPA (UNSW Research Agreement)
D. Waite J. Guan X. Wang	DEST International Science Linkage CH070180 - Fouling Control in Hybrid Membrane Systems : International Science Linkage Programme with Tsinghua University, China	DEST
T.D. Waite A. Feitz	Application of nano-sized zero valent iron particles to contaminant degradation through Fentons reagent oxidation	ARC Linkage Waste Technologies Australia





Key Researchers	Research Topic	Granting Organisation
T.D. Waite M. Melville I. White (ANU) R. Bush (USC) R. Collins	Reducing export of acid sulphate soil products (particularly iron, aluminium, phosphorus and organic carbon) as contaminants to coastal waters	ARC Linkage Tweed Shire Council
T.D. Waite L. Li (UQ) T. Howes (UQ)	Predicting Lyngbya blooms: impact of iron transformation kinetics on flux, distribution and rate of uptake of bioavailable iron and phosphorus	ARC Linkage Moreton Bay Waterways and Catchments Partnerships
D.Waite S. Chang	Membrane fouling in submerged hollow fibre membrane bioreactor systems: theory, modelling and fouling control	ARC
D. Waite A. Feitz J. Guan	Optimisation of ZVI Manufacture Extension of Optimisation	Orica
T.D. Waite, R. Collins	Element uptake by rice - root iron plaque formation and implication to nutrient and toxicant uptake	DEST International Science Linkages
D. Waite, S. Khan	ARC Linkage Project - Physico-Chemical controls on Growth, Toxicity and Succession of <i>Microcystis</i> and <i>Anabaena</i> species in Sydney Water Supply Reservoirs	ARC, SCA
X.Wang	Aluminium Forum Stage IV Phase 1 - Ozonation	Australian Aluminium Council Ltd
X.Wang	Hydrogen Sulfide analysis	ENSR
X.Wang	Works associated with the Alfred Rd Flux Hood Investigation	WSP Environment
D.Waite P. Kovalsky	Thickener Modelling Project	Outotec Australia Pty Ltd
Project Leader: J Williams (UK)	Barrier Dynamics Experiment (BARDEX), WorkPackage1: Barrier stability and Overwash – Williams et al (UK) WorkPackage2: Barrier Hydrology – Turner et al (UNSW) WorkPackage3: Swash sediment transport – Masselink et al (UK) WorkPackage4: Nearshore hydrodynamics and sediment transport - Williams et al (UK)	HYDROLAB III (European Union)





6) Our Staff

6.1) WRC Staff - Kensington

Director

Associate Professor Richard Stuetz

Business Manager

Robert Steel

Administrative Assistant

Robby Smith to May 2008

Kirra-Lee Dean from September 2008

Program Leaders

Dr Stuart Khan

Dr Greg Peters

Dr David Roser

Associate Professor Richard Stuetz

Professor David Waite

Volunteer

Lance Bowen

Research Staff

Leearna Brown

Dr Heather Coleman

Dr Richard Collins

Dr Shikha Garg

Dr Jing Guan,

Dr Rita Henderson, ·

Christine Kaucner

Dr Marcus Klein

Associate Professor Sven Lundie

Dr James McDonald

Dr Kate Murphy

Dr An Ninh Pham

Dr Andrew Rose

Matthias Schulz

Dr Michael Short.

Trang Trinh

Dr Ben Van den Akker

Dr Xianguang Wang

Dr Xiaomao Wang





6.2 Water Research Laboratory Staff– Manly Vale

Director

Dr Bill Peirson

Deputy Director

Dr Ian Turner

Manager

Brett Miller

Academics

Professor Ian Acworth,

Associate Professor Ron Cox

Dr Bruce Cathers

Dr Martin Andersen

Senior Project Engineers

Doug Anderson

James Carley

Dr William Glamore

Steve Pells

Dr Wendy Timms

Project Engineers

Alexandra Badenhop

Matt Blacka

Ian Coghlan

Alessio Mariani

Luis Mallen-Lopez

Duncan Rayner

Maureen Schwarz

Dr Laurent Tarrade

Conrad Wasko

Postdoctoral Fellows and Research Associates

Dr Chris Blenkinsopp

Anna Greve

Andrew McCallum

Consulting Specialists

Professor Ian King

Dr Rein Nittim

David Tolmie

Steve Wyllie

Technical and Administration

John Hart

Ross Mathews

Monika Stieler

Hamish Studholme

Joan Terlecky

Wendy Thomason-Harper

Robert Thompson

Library

Jane Fortt

Caroline Hedges





6.3 Visitors

Visiting Academics

Professor Nicholas Ashbolt,
University of Cincinnati, USA

Dr. Seyed Ali Azarmsa
Tarbiat Modares University, Tehran, Iran

Professor Andy Baker
Birmingham University, United Kingdom

Associate Professor Carlos Chernicharo
Federal University of Minas Gerais, Brazil

Dr Eric Dickenson
Colorado School of Mines, Colorado, USA

Associate Professor Jorg Drewes
Colorado School of Mines, Colorado, USA

Dr Manabu Fujii,
Tohoku University, Japan

Dr Andrew Kinsela
Australian National University, Canberra Australia

Dr Marion Minouflet
University of Geneva Switzerland

Dr Gareth Swarbrick
Pells Sullivan & Meynink, Sydney Australia

Visiting Students

Maxime Bonis
Ecole Normale Supérieure, Cachan, France

Lena Bruderreck
Bergische Universität Wuppertal, Germany

Astrid Fröhlich
Bergische Universität Wuppertal, Germany

Matthieu Kazmierski
SupAgro, Montpellier, France

Sebastian Moirat
Ecole Nationale Supérieure Agronomique de
Toulouse, France

Joaquin Sebastian Peral
Polytechnic of Valencia, Spain

Gabriel Rau,
University of Stuttgart, Germany

Gwenaëlle Richards
Ecole Normale Supérieure, de Chimie de Montpellier,
France

Martin Troester
University of Karlsruhe, Germany



Martin Troester
University of Karlsruhe,
Germany



6.4 PhD Students

LIVINGSTON, Daniel John (Ashbolt/Colebatch)
Institutions and decentralised urban water management

SANTIWONG, Suvinai Rensis
(Waite/Fane/Chang)
Analysis of compressible cake behaviour in submerged membrane filtration for water treatment

SEELSAEN, Nida (Stuetz/Moore/McLaughlan)
Development of an integrated approach to understanding managing and designing strategies and recycled organics filtration treatment system to control regional heavy metal contamination of stormwater

WESTRA, Seth (Sharma/Cordery)
Probabilistic forecasting of multivariate seasonal reservoir inflows: accounting for spatial and temporal variability.

Continuing Research Students & Topics

Altavilla, Nanda
Fate and transport of cryptosporidium in the terrestrial environment
Supervisors: D Roser, R Stuetz; Co-supervisors: N Ashbolt, D Deere

Asghar, Kamran
Water pricing in 1st and 3rd world (Sydney and Quetta)
Supervisors: I Cordery, A Sharma

Barnes, Rebecca Ruth
Development of a water management framework for developing countries
Supervisors: R Stuetz, D Roser; Co-supervisor: P Brown

Beavis, Paul Charles Christopher
Intermodal production systems
Supervisor: S Moore; Co-supervisor: I MacGill

Bernardi, Antonio
Surface water groundwater interconnectivity at a dryland salinity site
Supervisor: I Acworth; Co-supervisor: M Littleboy

Bligh, Mark William
Iron and phosphorus interactions in coastal waters
Supervisor: D Waite

Braga, Olga
Analysis of endocrine disrupters and pharmaceuticals
Supervisor: G Smythe; Co-supervisor: D Waite

Caldwell, Robert Herbert Duncan
Water resources management of irrigation water
Supervisors: I Cordery, A Sharma

Charles, Katrina Jane
Risk assessment at onsite sewage treatment systems in Sydney's drinking water catchments
Supervisor: N Ashbolt; Co-supervisor: D Roser

Cheah, Chin Hong
Kinematic wave modelling of surface runoff quantity & quality for small urban catchments in Sydney
Supervisors: R Cox, J Ball; Co-supervisor: W Peirson

Chowdhury, Shahadat Hossain
Probabilistic forecasting of hydrologic variables
Supervisor: A Sharma; Co-supervisors: I Cordery, J Ball

Chung, Jin
Development and application of cryptosporidium surrogates to evaluate water treatment
Supervisor: N Ashbolt; Co-supervisor: G Vesey

Coad, Peter William
Estuarine algal bloom prediction
Supervisors: B Cathers, D Van Senden; Co-supervisor: J Ball

Dasey, Gregory Reginald
Electrical tomography in coastal groundwater monitoring
Supervisor: I Acworth; Co-supervisor: I Turner

Dever, Stuart Anthony
Passive drainage and biofiltration of landfill gas
Supervisor: R Stuetz; Co-supervisor: G Swarbrick



Godrant,Aurelie
Role of superoxide in iron acquisition by marine phytoplankton
Supervisors: D Waite, P Treguer; Co-supervisors: A Rose, G Sarthou

Greve,Anna Katrin
Groundwater geophysics
Supervisor: I Acworth; Co-supervisor: B Kelly

Hambly,Adam Christopher
Fluorescence as a tool for adetection of failures in recycled water treatment
Supervisors: R Stuetz, S Khan; Co-supervisor: R Henderson

Han,Hyung Jin
Senolytic degradation of contaminants
Supervisor: D Waite; Co-supervisor: O Devos

Harley,Mitchell Dean
Regional scale climate of coastal erosion and shoreline changes based on long-term survey dataset and coastal imaging technology
Supervisor: I Turner; Co-supervisor: A Short

Hashim,Nor Haslina
Use of chiral pharmaceutical compounds to characterise sewage and sewage treatment
Supervisors: R Stuetz, S Khan

Howard,Elizabeth Helen
Coastal imaging analysis of near shore and coastal processes
Supervisor: I Turner; Co-supervisor: R Cox

Hung,Ju-Pin
Application of info systems to environmental material accounting tools
Supervisor: S Moore; Co-supervisor: G Low

Jakrawatana,Napat
Decision support tool for planning and design of sustainable regional biomass waste management and bioenergy production
Supervisor: S Moore; Co-supervisor: I MacGill

Jeremiah,Erwin Joachim
Hydrology
Supervisor: A Sharma; Co-supervisors: L Marshall, S Sisson, D Nott

Johnson,Fiona Michelle
Hydro Climatology
Supervisor: A Sharma; Co-supervisor: I Cordery

Jones,Adele Manda
Transformation and transport of contaminants and iron from acid sulfate soils
Supervisor: D Waite; Co-supervisor: R Collins

Jury,Karen Lilian
Investigation of the role of antibacterial drugs in municipal wastewater as a selective influence on the spread of bacterial resistance
Supervisor: R Stuetz; Co-supervisor: N Ashbolt

Khan,Urooj
Semi-distributed modelling
Supervisor: A Sharma; Co-supervisor: M McCabe

Khumkomgool,Aungkoon
Sediment behaviour in turbomachinery
Supervisor: W Peirson; Co-supervisor: B Cathers

Kwok,Sei Lung
Computational hydraulics
Supervisor: B Cathers

Lai,Elizabeth
Urban water sustainability framework
Supervisor: S Lundie; Co-supervisor: N Ashbolt

Le,Minh Nhat
Wastewater Treatment
Supervisor: R Stuetz; Co-supervisor: S Khan

Liu,Yi
Hydrology, remote sensing, climate variability
Supervisors: M McCabe, A Sharma; Co-supervisor: J Evans

Maruthai Pillai,Sashikala
Headspace analysis of chemical odorants
Supervisor: R Stuetz; Co-supervisor: S Moore

McCallum,Andrew Murray
Deep drainage studies
Supervisors: M Andersen, I Acworth

Miller,Christopher James
The transformation and implication of reactive oxygen species in natural aquatic systems
Supervisor: D Waite; Co-supervisor: A Rose

Morris,Bradley David
Infilling and sedimentation mechanisms at intermittently open-closed coastal lagoons
Supervisor: I Turner; Co-supervisor: R Cox

Parcsi,Gavin Peter
Chemical analysis of odorants from poultry facilities
Supervisor: R Stuetz; Co-supervisor: S Khan

Pui,Alexander Charles
Stochasitc hydrology
Supervisor: A Sharma; Co-supervisor: R Mehrotra





Rancic,Aleksandra Sanja
Groundwater levels in fractured rocks - climate
and land use impacts
Supervisor: I Acworth; Co-supervisor: W
Johnston

Rowley,Hazel Victoria
Decision making for sustainability
Supervisor: G Peters; Co-supervisor: S Lundie

Shand,Thomas D
On wave group dynamics in shallow water
Supervisor: R Cox; Co-supervisor: W Peirson

Singh,Sachin
Water and wastewater treatment and analysis
Supervisor: S Khan; Co-supervisor: R Stuetz

Sivret,Eric Claude
Nitrification process control using gas phase
nitrous oxide monitoring
Supervisor: R Stuetz; Co-supervisor: W Peirson

Sun,Quan
Contaminant degradation using nanosized zero
valent iron particle
Supervisor: D Waite; Co-supervisor: A Feitz

Thomas,Jacqueline Marie
Pathogen ecology within drinking water
biofilms
Supervisors: R Stuetz, S Kjelleberg; Co-
supervisors: M Storey, N Ashbolt

Torbaty,Mohammadali
Computational hydraulics and computational
fluid mechanics
Supervisor: B Cathers; Co-supervisor: W Peirson

Walker,James William
The exchange of oxygen at the surface of open
waters under wind forcing
Supervisor: W Peirson; Co-supervisor: M Banner

Widagdo,Aloysius Bagyo
Cohesive sediment transport under surface
wave action
Supervisors: B Cathers, W Peirson

Yan,Xia
Environmental Engineering
Supervisor: W Peirson; Co-supervisor: I Turner

Yilmaz,Abdullah Gokhan
Climate change hydrology
Supervisors: M McCabe, A Sharma; Co-
supervisor: J Evans

Zardari,Noor-ul-Hassan
An improved multicriterion analysis approach
to avoid subjectivity in irrigation water
allocation decisions
Supervisor: I Cordery; Co-supervisor: A Sharma



7) Publication

Book Chapter

Khan, S. J. (2008) Chapter 12: Urban Reuse & Desalination. In *Water Policy in Australia: The Impact of Change and Uncertainty* Crase, L (Ed) Resources for the Future Press, Washington, DC, 184-201. ISBN: 978-1-933115-58-0.

Leslie, G. and Khan, S.J. (2008) Chapter 4: Advanced water treatment technologies. In *Purified Recycled Water for Drinking: The Technical Issues*. Gardner, T., Yeates, C. and Shaw, R. (Eds) Queensland Water Commission: Brisbane, QLD, 87-121. ISBN: 978-1-7417-2565-0.

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8) Financial Report - UNSW Water Research Centre

	2008	2007
Income		
External Funds	\$6,080,230.22	\$4,717,798.74
UNSW Contribution	\$ 250,000.00	\$ -
Internal Revenue	\$ 62,285.01	\$ 353,069.42
Total Income	\$6,392,515.23	\$5,070,868.16
Expenses		
Payroll	\$3,413,289.51	\$2,825,315.26
Equipment	\$1,248,299.04	\$ 274,067.92
Materials and Expenses	\$ 837,734.37	\$ 795,785.66
Scholarships Stipends	\$ 317,434.51	\$ 211,112.28
Travel	\$ 306,729.81	\$ 208,080.53
Total Expenses	\$6,123,487.24	\$4,314,361.65
Opening Balance	\$1,117,770.98	\$ 573,356.73
Net Movement on Income and Expenses	\$ 231,989.14	\$ 499,236.63
Movement in Unpaid Invoices		
Closing Position	\$1,349,760.12	\$1,072,593.36
Unpaid Invoices	\$1,133,469.21	\$ 471,672.17

With the creation of the Water Research Centre, the 2008 results are now reported as the combination of activities for the different parts of the Centre. As a result of this change, the results are not directly comparable to the 2007 results, which were for CWWT only.

In 2008 the Centre received a LIEF Grant from the Australian Research Council. These grants are awarded on a competitive basis to provide funds for Infrastructure, Equipment and Facilities. The expenditure of this grant (along with partner contributions and funds from the University) is reflected in the large equipment expenditure in 2008.

LIEF related expenditure - \$939,707.67 for two triple quadrupole mass spectrometry units.

Notes:

1. The UNSW contribution listed is composed of \$190,000 (provided by DVC Research) and a school contribution of \$60,000 to supplement the funds provided by the ARC for a LIEF Grant mentioned above.

5. The Accumulated Funds amounts include the CWWT Staff Termination Preservation Account totals of \$132,528.00.

This account was set up as a specific provision for staff where a termination payment is due.