



GRAVITY FIELD STATION



NCGRT FLOATS RAFT



TRAVELLING FELLOW

THIS VOLUME OF THE CENTRE NEWSLETTER SHOWCASES SOME OF OUR EXCITING WORK AND INSTALLATIONS HAPPENING IN THE VARIOUS NODES. WE ALSO PROFILE TWO OF OUR MOTIVATED AND ENTHUSIASTIC STUDENTS AND FOLLOW THEIR JOURNEY WITH THE NCGRT.

FROM THE DIRECTOR



Welcome to the latest edition of *ReSource*. As you will read in the following pages the Centre is in the midst of some exciting and groundbreaking activities. We are swiftly travelling towards the end of 2011 and have a lot to keep us busy in the next few months.

It has been a busy time for the Centre stakeholders with our Industry Liaison Advisory Committee (ILAC) meeting in September to discuss the forthcoming Road to Impact Project and also to discuss the 2012 Business Plan.

Our Advisory Board and Research Management Committee also met in late August to discuss ongoing Centre business.

We are also in the midst of reviewing the 65 applications we received from some very talented individuals, through our 2011 PhD/Post Doc Recruitment drive. We hope to be offering appointments in the coming weeks to the successful applicants.

A core group from the Centre has just returned from Minneapolis after attending and presenting at the Geological Society of America (GSA) Annual Exposition. We had a very successful trip and were delighted with the response our presence had with potential students and research partners.

We are looking forward to returning to the GSA next year to further raise

the profile of the Centre as well as build a platform on which to strengthen our relationship with international researchers.

A good news story to note is the official launch of the SuperScience Headquarters at Wellington, NSW. The SuperScience event coincided with the launch of our state-of-the-art Centrifuge permeameter, which is the keystone of our infrastructure investment. It was a fabulous opportunity to showcase our facilities and investments in groundwater infrastructure. Please see the full story on page 5.

CRAIG SIMMONS

RESEARCH HIGHLIGHTS



A NOVEL PLATFORM FOR LONG TERM CONTINUOUS MONITORING OF GROUNDWATER – SURFACE WATER INTERACTIONS IN WETLANDS AND LAKES
Program 3 within the Centre aims to better understand groundwater-surface water (GW-SW) interactions. This is important both for understanding hydrological systems and for managing surface and groundwater resources.

As part of this effort Centre staff and students Ian Cartwright, Harald Hofmann and Benjamin Giffedder have been developing new field based chemical methods to understand how GW-SW interactions change over short time scales (hours to weeks), particularly in response to storms and floods.

A new diffusion membrane has been developed to continuously sample radon,

a radioactive noble gas that can be used to trace groundwater discharge to surface water bodies. This membrane, as well as a radon monitor and associated peripherals, have been deployed in the Sale Common Wetland aboard a raft, aptly named the SS-Monash, (pictured) constructed in our workshop. It is aimed at long-term continuous monitoring of GW-SW exchange.

The set-up is powered by 2 x 80W solar cells, which has managed to power the raft through the long Victorian winter. The setup has now been running continuously with radon measurements every 2 hours since the 25th of June this year. It has experienced two major floods of the Thomson River (it's been the wettest year in 36 years!) and wind speeds up to 60 km per hour.

Other than a small fish being caught in the intake line, it has produced high-quality data. The initial data suggests that groundwater input changes rapidly in response to water on the flood plain, e.g. following flooding, which may be associated with pressure loading of the shallow sedimentary aquifer system.

The radon data will be combined with box modelling to quantify groundwater inputs and also to assess how well theoretical degassing models predict radon loss from surface water bodies such as lakes and wetlands over long time periods.

INDUSTRY TRAINING

GROUNDWATER FOR DECISION MAKERS

This Course held in Canberra in September was delivered by a team of leading groundwater professionals from industry, universities and research agencies including several researchers from the Centre. The one day course designed for professionals in consulting, research and public authorities, 26 of which were in attendance, gained an understanding of groundwater terminology, processes, concepts and fundamental knowledge of the policy and legal issues affecting groundwater management to better inform decision making processes.

FEFLOW MODELLING WORKSHOP

The workshop held in Adelaide in September was led by Alexander Renz who works as a groundwater and porous media flow consultant at DHI-WASY and is a Senior FEFLOW trainer. The extensive workshop was held over 5 days and included hands-on groundwater modelling using FEFLOW in its application to two and three-dimensional groundwater problems.

UPCOMING COURSES – 2012

SOIL AND GROUNDWATER POLLUTION

This course will give participants an understanding of the important groundwater processes related to soil and groundwater pollution. The course will review the fundamentals of groundwater hydrology, and the mechanisms of soil and groundwater contamination. Different types of contaminants will be considered, including LNAPLs (light non-aqueous phase liquids) and DNAPLs (dense non-aqueous phase liquids).

Case studies will be extensively used to explore the different concepts. Course content will thoroughly cover site characterisation and remediation options (including natural attenuation), focussing on methods that are most suitable for different contaminant types. General principles of risk assessment will also be discussed. Attendees will be led through the process of selecting and designing remediation systems based on geological, chemical, and biological factors, as well as an in-depth study of the integration of risk into the remediation process.

This course is presented by two eminent professionals, Robert M. Cohen, Principal Hydrogeologist at Tetra Tech GEO; and Tyler Gass, Executive Vice President of Tetra Tech GEO.

To register and for information about other courses visit: www.groundwater.com.au

VISITING SCHOLAR

EMERITUS PROFESSOR JOZSEF TOTH, DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES, UNIVERSITY OF ALBERTA, CANADA

The NCGRT takes great pleasure in welcoming Dr Jozsef Toth to our shores in December this year. He is most distinguished in the field and we are honoured to be able to host him at the Centre. We are grateful to Dr. Andrew Love and the Great Artesian Basin Team, operating out of Flinders University in SA, who were instrumental in arranging this visit.

Tóth's biggest breakthrough is a mathematical formula used to explain how groundwater moves under the influence of gravity. It is used to predict the location of drinking water, the migration of hydrocarbons, the generation of various ore deposits, and to understand the distribution of vegetation and the origin of soil salinity.

His work has been recognised in numerous ways.

Amongst other awards, Toth won the first O.E. Meinzer Award from the Geological Society of America's Hydrogeology Division for his earliest publications and in recognition of distinguished contributions to hydrogeology.

We will advertise details about activities around Jozsef's visit as it gets closer.

'When it comes to predicting the movement and location of groundwater, few in the world have made as big a splash as Dr. József Tóth.'



STUDENT PROFILE

'I will develop a 3D hydrogeological model for the whole Cressbrook system, and within this framework interpret the hydrology. ...'

ADAM KING, QUEENSLAND UNIVERSITY OF TECHNOLOGY

WHAT IS YOUR PROJECT?

I am a PhD student at QUT in Brisbane in the NCGRT Program 1A on aquifer characterisation. My project is to develop a conceptual model of a catchment and the various aquifers within it, and to investigate hydrological processes. The location is Cressbrook Creek, a small subcatchment of the upper Brisbane Valley, which contains Lake Wivenhoe. This is the major dam that filled during the recent floods. I will develop a 3D hydrogeological model for the whole Cressbrook system, and within this framework interpret the hydrology. This will also include major ion chemistry, stable isotopes and water level fluctuations to investigate groundwater flow processes. I will also determine a water balance and water fluxes between the alluvial aquifer system and the atmosphere, the bedrock and surface water. Recharge processes and groundwater extraction are also part of this.

WHAT DO YOU HOPE TO ACHIEVE DURING YOUR TIME AT THE NCGRT?

I want to develop some strong applied research into groundwater systems and produce a quality thesis. My particular interest is in the conceptual hydrogeological models and geological controls on water movement, and how hydrochemistry can be used to confirm this. I am keen to get this work published and also present it at conferences. I am also keen to interact with other PhD and postdoc researchers and

find out what they are doing.

WHAT WOULD YOU LIKE TO SEE ACHIEVED 'BIG PICTURE' IN YOUR GROUNDWATER RESEARCH IN 2011?

I would like to see more work on large scale regional groundwater systems based on integration of data from groundwater studies at various scales, in order to develop an understanding of how the whole system works.

HOW LONG HAVE YOU BEEN IN YOUR ROLE?

I have been working on my PhD since March 2010, but I was already in Brisbane where I had worked as a hydrogeologist with a consulting company for three years.

WHERE DO YOU SEE YOURSELF IN 5 YEARS?

I very much enjoy hydrogeology as a profession, both the field work and the data interpretation. I hope to improve my skills and experience and be able to get a challenging position where I can apply this. I am rather interested in the investigations done at Geoscience Australia, but am also interested in working in the coal seam sector as there are real challenges there.

WHAT DO YOU ENJOY DOING IN YOUR LEISURE TIME?

I am really into cricket, both playing and watching. I also enjoy bushwalking and camping and catching up with friends.

RESEARCH HIGHLIGHTS

CENTRE FUNDED GRAVITY FIELD STATION

A new gravity field station, funded by the NCGRT, will be operated by Centre staff Mr Sam McCulloch and Dr Anna Greve, who both received specialised training in the use of the facility in Colorado last year. The station has been set up on the Liverpool Plains as part of a research program studying water storage in clay sediments and leakage to underlying aquifers.



The equipment at Liverpool Plains includes a gravimeter that can measure changes in gravity as small as 1 μ Gal, which is capable of

detecting the effect of 2.4 cm rainfall on soil moisture levels. A μ Gal is a millionth of the unit of acceleration known as a Gal (Galileo), defined as 1 centimetre per second squared.

The solar-powered temperature-controlled gravity station has been set on a 10m deep foundation to ensure a constant height datum in the shrinking and swelling clays at the site. The station was assembled and tested at the UNSW Water Research Laboratory in Sydney before being transported to the site.

While groundwater levels in aquifers can be accurately measured using pressure loggers in boreholes, measuring the moisture content of soil is more challenging.

Soil moisture forms an important connection between surface water and groundwater, particularly in situations where rainfall recharges underground supplies by percolation to the water table. Changes in measurements of gravity at a location over time can be related to changes in soil moisture content there. Gravimeters are used to accurately measure these minute changes in gravity.

MANAGED AQUIFER STORAGE AND RECOVERY IN FARMING LANDSCAPES

Centre staff and students including Program 5 Leader Tony Jakeman and Chief Investigator Allan Curtis are about to embark on an interdisciplinary, cross program and multi-stakeholder project assessing the feasibility of aquifer storage and recovery using water from large flood events to underpin conjunctive use of surface and ground water in agricultural landscapes in the Murray-Darling.

Managed Aquifer Recharge (MAR) in Australia has largely focused on small-scale opportunities to reuse reclaimed water from urban areas. In the Burdekin, a farming landscape in northern Australia, surface water has been used to recharge aquifers and prevent the contamination of irrigation water by saline water from the nearby ocean.

This project will build on these experiences but is distinctive in that the focus is on the use of water from large floods in agricultural landscapes to accomplish environmental as well as economic and social benefits. In part, this work has not been undertaken because the focus has often been on surface water

and because of the difficulties in bringing together an interdisciplinary team to assess the feasibility of the concept.

An argument can also be made that Australian governments have typically focused on those actions that can be implemented quickly.

The NCGRT has been the catalyst in bringing the research team together and providing critical resources to begin the next steps.

Three Centre PhD students, Arshad Muhammed, Leslie Illado and Andrea Rawluk will commence studies examining the technical feasibility of a series of engineering options; the environmental benefits of lifting water tables and reconnecting groundwater and surface water, and governance arrangements needed to support MAR.

The NCGRT has existing case study sites where

After drilling the foundation hole in May 2011, the station was installed in June 2011 and is now fully operational.

The station will measure changes in soil moisture levels for at least the next 3 years. The gravity data obtained in the study will be used to quantify changes in soil moisture storage at the field scale. This data is essential for improving understanding of drainage processes, close the water balance and to quantify the effect of groundwater abstraction.

multiple programs are currently working. The advantages of working in these locations are that the existing focus of research effort is generating a solid knowledge base and there are sufficient resources for effective stakeholder engagement. The MAR project will be based in the Murray-Darling, with work in the Namoi catchment and potentially, also the Gwydir, Macquarie and Lachlan catchments.

A national workshop will be held in April 2012 to draw together expertise across Australia to explore the potential of MAR in agricultural landscapes using large flood events to make an important contribution to improved management of water resources in the Murray-Darling.



INDUSTRY HIGHLIGHTS

THE AUSTRALIAN WATER R&D COALITION

The National Centre for Groundwater Research and Training (NCGRT) is uniquely represented on the newly-formed Australian Water R&D Coalition (AWRDC) which aims to foster an environment of cooperation and collaboration within the water industry, in which research dollars will go further, through pooling resources and eliminating duplication, and in which knowledge and adoption can be leveraged across all stakeholders.

'By working together, we hope to make finite resources go further, for a greater achievement than each could manage working in isolation – and a greater net benefit for the Australian community.'

In Australia, we are quite fortunate. Our water industry is the envy of many countries for its supply of high quality water to the vast majority of our population. In part, the reason we can do this is our significant investment in water research and development. This includes investments made directly by utilities, investment from both the state and Commonwealth governments and investment from private industry and the university sector.

It is estimated that more than A\$50 million is invested annually in Australian urban water research and development (R&D): so who manages these funds?

There are a range of key groups in this area and nine of them have banded together to form a coalition that seeks to achieve more than the sum of its parts. Along with the NCGRT the other members of the AWRDC include:

- Australian Water Recycling Centre of Excellence (AWRCE)
- Goyder Institute for Water Research (GIWR)
- National Centre of Excellence in Desalination (NCED)
- National Water Commission (NWC)

- Urban Water Security Research Alliance (UWSRA)
- Victorian Smart Water Fund (SWF)
- Water Quality Research Australia Limited (WQRA)
- Water Services Association of Australia (WSAA)

These nine Australian agencies that comprise the Australian Water R&D Coalition may have been formed through a range of different mechanisms and, as membership-based, Commonwealth or state initiatives be different in character, but they share a collective goal to improve the water management and research and development investment in Australia.

The AWRDC has an international precursor in the form of the Global Water Research Coalition (GWRC), which was formed in 2002 in response to a growing need for international collaboration across the urban water cycle.

The Centre is delighted to be a part of such a worthy collaboration and be at the forefront of water initiatives in Australia.

EVENTS

UNVEILING OF CENTRIFUGE FACILITY AS PART OF THE GROUNDWATER EIF SUPERSCIENCE HEADQUARTERS LAUNCH

The unveiling of this centrifuge (as profiled in Vol 2 of ReSource) demonstrates the NCGRT's ongoing commitment to building Australia's groundwater research infrastructure; and coincided with the launch of the Groundwater Infrastructure Fund SuperScience Headquarters at Wellington, NSW headed up by NCGRT SuperScience Director Ian Acworth.

The centrifuge project, led by Wendy Timms, is one of the only core permeameter centrifuges in Australia capable of direct testing of low permeability materials, such as clays. Understanding the permeability of clays is important for analysing the movement of water and other fluids within the earth. It will become an important resource for coal seam gas and CO₂ sequestration studies, as well as for understanding groundwater flows.

The SuperScience project is delivering six highly instrumented and coordinated field research sites around Australia that will

provide critical, high density data about groundwater to researchers for the first time. NCGRT program leaders and chief investigators are involved in building and leading these site developments.

The sites are funded through a \$15 million grant from the Government's Education Investment Fund and will also establish long term monitoring for climate change impacts on groundwater.



'The SuperScience funding provides a major infrastructure investment that significantly enhances the capacity and capability of the Centre. SuperScience and NCGRT are both complementary and synergistic - a natural marriage between people, knowledge and infrastructure.'

Professor Craig Simmons

AWARDS



'This gives me an opportunity to demonstrate my research and act as a research ambassador for Flinders University and the NCGRT...'

OVERSEAS TRAVELLING FELLOWSHIP

YUEQING STEPHEN XIE, FLINDERS UNIVERSITY

WHAT DOES THIS TRAVEL FELLOWSHIP ENTAIL?

The Overseas Travelling Fellowship is the most prestigious and competitive award offered by Flinders University to higher degree research students. It selects up to two students to study abroad with relevant renowned professors and research teams for a maximum period of six months. The grant of this travelling fellowship indicates the recognition of both the achievement of my PhD research and the capability of independent study. This fellowship allows me to study with several professors in Germany and the United States, each for three months. This also gives me an opportunity to demonstrate my research and act as a research ambassador for Flinders University and NCGRT overseas.

WHAT ARE PLANNING TO DO WHILE YOU ARE AWAY?

The research I have been doing during my PhD study is about the assessment of groundwater movement purely driven by the density difference between two miscible fluids in porous media. What I'm planning to do overseas is an extension of my PhD research in order to improve my understanding of these groundwater process and see what people outside are doing. I will try to develop my mathematical skills to analyse some problems associated with this process while working with Professor Diersch at DHI-WASY Groundwater Modeling Center

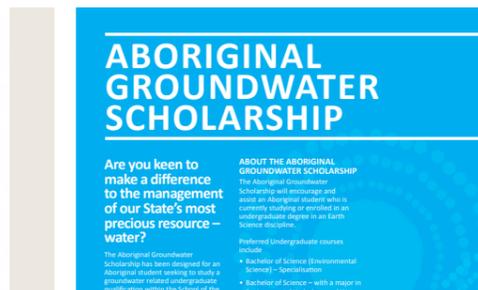
and Professor Graf at the University of Hannover in Germany. I'm also hoping to conduct some relevant field work and possibly build a three dimensional numerical model with Professor Sharp at the University of Texas at Austin and Professors Van Dam and Wood at Michigan State University in the US.

WHAT WILL WINNING THIS AWARD CONTRIBUTE TO YOUR CAREER?

This travel is quite important to my research and future career as this will extend my horizons and examine my capability. This travel will also enrich my knowledge, improve my skills and build the foundation for further collaboration worldwide. Given that I'm approaching the end of PhD study, this is a fantastic opportunity to seek comments from external experts on my thesis and I can incorporate their advice to ensure the quality of the final thesis.

WHAT WILL THIS AWARD ALLOW YOU TO CONTRIBUTE TO THE NCGRT AND TO GROUNDWATER KNOWLEDGE?

As a research ambassador, my travel will allow me to introduce part of the diverse groundwater research that NCGRT has been doing to a broad audience overseas and to establish / enhance linkages between NCGRT and those distinguished Professors. Considering the duration and the schedule, my contribution to groundwater knowledge might be limited. But I sincerely hope my trip would attract more students / researchers to come and work in this large groundwater research centre, and therefore to reinforce our team and advance our knowledge.



SILVER MEDAL

On June 27 Program 5 Leader Tony Jakeman was presented the Silver medal of Masaryk University for his contributions to environmental modelling. This was awarded prior to Tony delivering his keynote presentation on Integrated Environmental Modelling and Decision Support at the International Symposium of Environmental Software Systems held in Brno, Czech Republic. Congratulations Tony!

EUREKA AWARDS

The Connected Waters Initiative (CWI) Team was declared a finalist in the 2011 Australian Museum Eureka Prizes for Science. The nomination is for the Professor Peter Cullen Eureka Prize for Water Research and Innovation that recognises outstanding contribution to water resource management. The CWI Team team includes Professor Ian Acworth, Associate Professor Bryce Kelly, Dr Martin Andersen, Dr Anna Greve and Dr Wendy Timms; all of whom are researchers at the NCGRT.

ABORIGINAL SCHOLARSHIP

The co-funded NCGRT and the SA Department for Water Aboriginal Groundwater Scholarship was nominated in the National 2011 Diversity@work Awards and was selected as a finalist. We are certainly proud that this scholarship is the first of its kind in the field and that is attracting the attention of such high profile awards.

ANNOUNCEMENTS

MEDIA

The Centre is being profiled in the latest edition of the prestigious US National Ground Water Association Journal. The column features an in-depth look at the Centre's research programs and current projects; and offers the reader an insight into the investment the Australian Government is making to improve groundwater knowledge in Australia. It also highlights our international collaborations across research as well as

our industry training program.

VISITORS

The Centre hosted the 2011 Darcy Lecturer Stephen E. Silliman, PhD who presented 'Development of Reliable Hydrologic Data Sets in Difficult Environments: Case Studies from Benin, West Africa.'

The Centre was also proud to host the 2011 McEllhiney Lecturer Mr Tom Christopherson who shared his insights into Water Well Technology.

NEW STAFF

The Centre team welcomed aboard two new staff members Anna Cejko in the Business Performance Analyst Role and Michelle Fahey as Executive Officer. We look forward to working closely with them on Centre activities.

GW SUMMIT 2012

Submit Your Session Proposal for 2012 NGWA Ground Water Summit: Innovate and Integrate — Succeeding as a Groundwater Professional in a Water-Short World. Plan now to join

fellow groundwater industry professionals at the 2012 NGWA Ground Water Summit, May 6-10, 2012 in Garden Grove, California. Abstracts close on Nov 28.

IPAD2 PRIZE FOR BEST SUMMER SCHOOL POSTER NOV 28 - DEC 2

A coveted ipad2 will be awarded to the winner of best poster presentation at this years summer school, so get busy on those posters! A reminder to all students if they haven't registered that they **MUST** register their attendance for the

Summer School ASAP. The program and any additional information is available by contacting our Executive Officer Michelle Fahey.