NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 98 SEPTEMBER 2001

A NOTE FROM THE DIRECTOR

Professor Russell Mein

Inside...

REVIEW OF THE CRC FOR CATCHMENT HYDROLOGY

The Commonwealth Government currently funds some 65 Cooperative Research Centres (CRCs) in its CRC Program. These cover a wide range of research areas, and are given individual responsibility for planning their activities to best suit their particular field of endeavour. As part of the funding arrangements, CRC objectives and activities are set down in quite detailed contract agreements. With the considerable investment of public funds over their seven-year terms, all CRCs are required to undergo major external reviews at the end of Years 2 and 5.

The theme for the Second Year Review is 'Strategic Direction', with the review conducted in two stages:

Stage 1 – is an independent scientific and technical review of the CRC's research activities. It is required as an input into Stage 2, to enable a comprehensive review of all the activities of the CRC.

Stage 2 - addresses the CRC's strategic direction, cooperation, application of research, education, training, management, budget and performance evaluation. The Stage 2 panel also reviews the approach, methodology and conclusions of Stage 1 so that it can provide a consolidated assessment of the CRC's progress for consideration by the CRC Committee.

Our Stage 1 Review

The Stage 1 Review of the CRC for Catchment Hydrology was held on 24-26 July 2001, with a scientific panel consisting of:

Professor David Maidment, University of Texas [Chair]
Professor Larry Band, University of North Carolina
Professor John Lovering, Chairman, Environment Conservation Council, Victoria, and
Mr Jim Miller, CRC Visitor.

The Panel members have had substantial experience in catchment scale research and its application, and we believe are very well suited to determine whether the CRC is on track to deliver its mission of delivering predictive capability for land and water managers at catchment scale.

To help them make their assessments, comprehensive material was prepared in advance on our research programs and projects (descriptions, methodology, expected outcomes, budget), together with copies of our Business Plan and annual reports.

For the face-to-face component of the review, program teams presented details of research in progress and responded to quite incisive questioning. Even though the core research projects were only 18 months into their 3-year terms, it was pleasing to me to see how much had already been achieved.

The Panel thought so too, and delivered a 28-page report which detailed their findings. In what was a very positive and constructive document, the Panel gave us generally high praise, but with important pointers for success in achieving our mission. These pointers were expressed in the form of recommendations to more quickly define a conceptual framework for the modelling toolkit, and to strengthen the linkages between the Sustainable Water Allocation Program and other programs.

Overall, we were well pleased with the assessment given our CRC by this independent Stage 1 Review Panel; a tribute to the quality and dedication of all involved in the CRC's research programs.

One quote I'd especially like to highlight concerns an aspect fundamental to the rationale for the CRC Program (i.e. the establishment of strong linkages between researchers and the users of research):

Particularly compelling to the Panel members from the United States was the degree of stakeholder involvement in the CRC and the evident close relationship between the knowledge produced by the CRC and its application in improving professional practice by the stakeholders. These reviewers have seen nothing comparable to this synergy between the research and application communities in the United States.

A strong endorsement for the CRC model indeed!

Next steps

The Stage 1 Panel's report, and the Board's response to its recommendations, will be considered by our Stage 2 Panel on 1-2 November 2001. Their assessment will be the subject of a future *Catchword*.

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CRC PUBLICATIONS LIST

Copies of the Publications List are available on request from the Centre Office on 03 9905 2704 or can be downloaded from the CRC website at

www.catchment.crc.org.au

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PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Rob Vertessy

Water quality model developed - EMSS

Readers of Catchword will be aware that our CRC has been working with the South East Queensland Regional Water Quality Management Strategy to produce a catchment water quality model called the EMSS (Environmental Management Support System). We are proud (and relieved) to announce that we have now completed version 1.0 of the software. It will become available to the public as a beta release later this month when the CRC runs a training workshop in Brisbane for stakeholders. So, what does the EMSS do you ask? I've discussed that in previous editions of *Catchword*, but briefly recapping here....

Scope of model and its application

The EMSS segments the south-east Queensland region (22,500 km^2) into 13 catchments and 180 sub-catchments, interlinked by over 2,000 km of river network, and punctuated with 7 major water storages. The model predicts daily runoff and exports of TSS, TP and TN from each sub-catchment, then routes these through the river network. It also predicts the trapping of pollutants and modification of the flow regime by dam storages. The water and pollutant balance is rounded-off by accounting for extractions and point-source discharges. Users of the EMSS can easily predict how land-use, land management practices and climate impacts on runoff and pollutant movement.

Modelling framework used

The EMSS has been developed using the Tarsier model development environment (in turn built using Borland C++ Builder) which has been developed by Fred Watson and is being considered as one of the 5 possible modelling frameworks for adoption in the CRC's modelling toolkit. The EMSS software has been built by Joel Rahman, Fred Watson and Shane Seaton. A large team of CRC researchers has contributed to its design and testing though, with significant input from Sue Cuddy, Francis Chiew, Phil Scanlon and Frances Marston. To these people and the many others who helped us, I record my heartfelt thanks.

Lessons for the CRC's modelling toolkit

So, apart from building some neat software, what did we learn from the EMSS experience and what does it mean for the CRC's bigger vision of a modelling toolkit?

Interacting with stakeholders

Well, firstly, I'm absolutely convinced about the value of stakeholder consultation prior to and during the development of the software, despite the fact that it took quite a lot of effort.

Our stakeholders generously gave their time and provided us with very good focus as they knew exactly what they wanted. Their engagement affected a sense of ownership, which I believe will greatly enhance the adoption of the software and results from it.

I found it particularly useful interacting with a local consultant (Tony McAlister of WBM Oceanics) who not only had a good local knowledge of the catchment and management practices, but also an intimate understanding of what clients wanted to see in a model. Having such a person on the team also provides an invaluable bridge between the scientists building the model and the stakeholders who want it applied far and wide. Tony and his team have become the local specialists to apply the model, keeping the development team free to move on to new things. We'll still be there in the background providing support to Tony and others applying the model but our expectation is that our input will not be needed for long.

Modern programming approaches

From a software engineering point of view, I've also been convinced of the value of using a modern programming paradigm.

As someone involved in the development and dissemination of clunky old Fortran programs, I was astounded to see how quickly and effectively we could build the EMSS using an object-oriented, rapid application development environment (to wit, Borland's C++ Builder). Our software engineers were able to design and build the software in just over a year, despite the fact that they put considerable effort into the development of core resources in the Tarsier system that the EMSS sits within (along with several other catchment models).

However, to me, the most gratifying aspect of having developed the EMSS using Tarsier is that we can now reuse much of the code in other modelling projects. Resident in Tarsier now are a range of data handling, pre-processing and visualisation tools that have generic application to catchment modelling problems. By accessing these we can dramatically reduce the effort required to build future models of catchment behaviour.

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PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Mark Littleboy

Project 2.3 - Predicting the Effects of Land Use Changes on Catchment Water Yield and Stream Salinity

Aim of project

The overall objective of this project is to predict the regional scale impacts of afforestation and other land-use changes on mean annual and seasonal catchment water yield, groundwater recharge, and stream salinity. Within the project, six distinct tasks have been defined:

Task 1 Development of water balance model for predicting the impact of vegetation and other land-use changes on mean annual catchment water yield

Task 2 Estimating the water storage and permeability at catchment scale

Task 3 Develop prediction of partitioning of non-transpired water into groundwater recharge and surface runoff including that under pasture

Task 4 Extension of the simple water balance model to account for spatial and temporal variability in catchment properties and climate

Task 5 Predict the effect of land-use changes on saturation areas and runoff generation

Task 6 Determine the impact of land-use changes on salt loads and stream salinity

Preliminary work on Task 3

This update describes some preliminary work undertaken under Task 3. It focuses on the Department of Land and Water Conservation (DLWC) component under Task 3. The Victorian Department of Natural Resources and Environment are also undertaking extensive tree water use modelling using 3PG and pasture water balance modelling. These activities are not described in this update.

The aim of Task 3 is to increase our capacity to estimate groundwater recharge under different land-use and climate conditions. Within Project 2.3, there is a heavy emphasis on the top down modelling approach illustrated in Zhang et al. (1999). From an extensive worldwide database of experimental rainfall and runoff data, they empirically defined simple relationships between average annual evapotranspiration and average annual rainfall.

The challenge for Task 3 is to partition the non-transpired water into runoff and recharge pathways. But, this partitioning cannot be inferred directly from the original relationships, nor can it be calculated from the original dataset, nor are detailed datasets available to build empirical relationships. Consequently, a more mechanistic or physically-based approach is required to quantify the runoff and recharge pathways. With the insight gained from a more rigorous modelling study, we will develop a simpler and more generic recharge model that will complement the original Holmes and Sinclair type relationships.

Quantifying runoff and recharge

The approach proposed is to apply unsaturated zone water balance models to quantify the runoff and recharge pathways under different climatic regimes, soil type, land-uses and topography. These analyses are being undertaken within DLWC recharge modelling projects that are being undertaken under the NSW State Salinity Strategy. DLWC's role in Project 2.3 is to extensively explore and analyse the results from these State projects to build simpler and more generic recharge relationships. Without the additional resources dedicated to the NSW State Salinity Strategy recharge projects, it would not have been possible to apply such a comprehensive approach to develop a simpler recharge model within Project 2.3.

Results of central NSW catchment

The analyses presented here are for the 1690 km^2 Mandagery Creek subcatchment located within the Lachlan River catchment, in central NSW. Mandagery Creek has been used as a test area to develop a methodology for spatial recharge prediction for all of NSW. A spatial version of PERFECT, a daily water balance and cropping systems model, is initially being used. PERFECT will be replaced by a more spatially explicit water balance model over the next 12 months. Data sources for the analyses presented here are:

- Daily weather data were obtained from the Qld Department of Natural Resources and Mines DataDrill and Patched Point Datasets;
- Soil units were defined from existing soil landscape mapping, with each unit further subdivided on the basis of landscape position. Soil physical properties were assigned to each soils unit using existing soil physical properties datasets; and
- Four different land-uses were defined from land-use maps and through consultation with regional DLWC and NSW Agriculture staff. These land-uses were forest, open woodland, pasture and a wheat-canola cropping rotation.

NEW TECHNICAL REPORT

IMPLEMENTATION OF A MEAN ANNUAL WATER BALANCE MODEL WITHIN A GIS FRAMEWORK AND APPLICATION TO THE MURRAY-DARLING BASIN

by

Andrew Bradford
Lu Zhang and
Peter Hairsine

Report 01/8

The report describes the implementation of a simple water balance model in a GIS (Geographic Information System) framework for assessing average annual streamflows (water yield) under different land-use scenarios in the Murray-Darling Basin. The model requires only catchment percentage forest cover and mean annual rainfall. The report describes the water balance model, its input data and the process required to prepare those data.

Copies available through the Centre Office for $27.50.

NEW EVAPOTRANSPIRATION AND RAINFALL MAPS FOR AUSTRALIA

Where to get them!

The CRC for Catchment Hydrology and the Bureau of Meteorology have recently completed a project to produce national maps of evapotranspiration for Australia.

The map set is now available for $33 plus postage and packaging.

They can be purchased from:

1. Publications Section, 9th floor, 150 Lonsdale St Melbourne. tel: 03 9669 4000 (main switch) and ask for Publications

OR

2. Bureau Regional Offices (all capital cities) Contact details for each Regional Office are available at http://www.bom.gov.au/inside/contacts.shtml

Information about the climate atlas map sets and the digital map data sets can also be obtained from: National Climate Centre Ph: 03 9669 4072 Email: webclim@bom.gov.au

Technical queries about the evapotranspiration modelling can be referred to Dr Francis Chiew at The University of Melbourne email f.chiew@civag.unimelb.edu.au

Any technical queries about the mapping should be referred to Graham de Hoedt tel 03 9669 4714 email: g.dehoedt@bom.gov.au

These following results must be considered preliminary only. *Figure 2.1* shows the relationship between average annual evapotranspiration and average annual rainfall for four areas within Mandagery Creek with average annual rainfall ranging from 650 to 810 mm per year. Some key points from *Figure 2.1* are:

- Evapotranspiration (ET) from forest is higher than for pasture, and the difference between forest and pasture ET increases for higher average annual rainfalls. These results are consistent with the trends reported by Zhang *et al.* (1999); and
- ET from cropping is lower than for forest or pastures. This trend is obvious, but the modelling has allowed us to quantify the differences.

Figure 2.2 shows some preliminary relationships between land-use, soil type and estimated drainage for two areas within Mandagery Creek. Drainage has been plotted against total plant available water to 4m to show the effects of soil type on drainage. Some key points are:

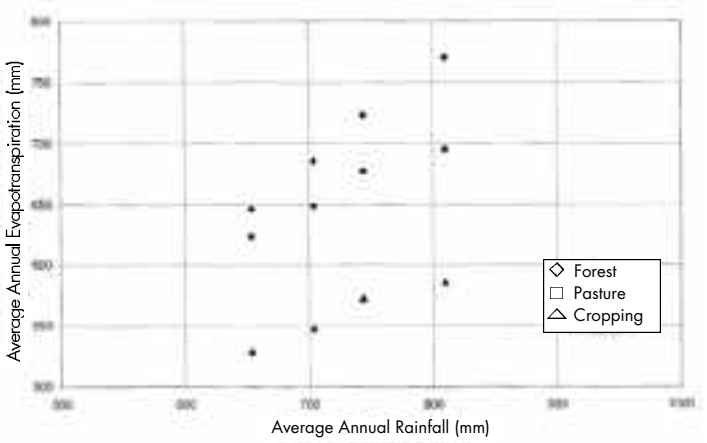

Figure 2.1 Relationship between average annual evapotranspiration and average annual rainfall for four areas within Mandagery Creek.

Table 2.1 Limitations of analyses and proposed methodologies to address them

Current limitation	**Proposed methodology**
Limited spatial extent	Preliminary results are for Mandagery Creek, that has been used as a test area to develop the spatial modelling methodology. The geographical extent of the recharge modelling will be extended to all major catchments of the NSW portion of the Murray Darling Basin by the end of September 2001. After that time, we can start exploring broader generic relationships applicable for a wide range of environments.
Limited range of land uses	For the preliminary modelling, only four land uses and no land management options have been considered. Over the next 1-2 years, the recharge modelling within DLWC will increase to include all major land uses and land management strategies. This will enable us to continually improve the generic relationships within Task 3 of Project 2.3.
Do not explore effects of soil properties	The results presented in *Fig 2* only consider plant available water capacity. Data will be reanalysed based on the outcomes from Task 2.
Based on 1-dimensional water balance modelling	The estimates of drainage from the 1-dimensional modelling will be partitioned into recharge and lateral flow components based on more detailed soil water modelling using HYDRUS 2D. Initial analyses reveal a substantial lateral movement of water in many landscapes that will provide us with a "first-cut" approach for partitioning lateral flow. Extensive and more detailed analyses and associated field work over the next 1-2 years will dramatically improve our capability in this area.
Do not quantify the effects of rainfall seasonality	The results presented in *Fig 2* do not consider rainfall seasonality. Under Task 4, rainfall seasonality indices are being developed and once available, will be incorporated into the Task 3 analyses.

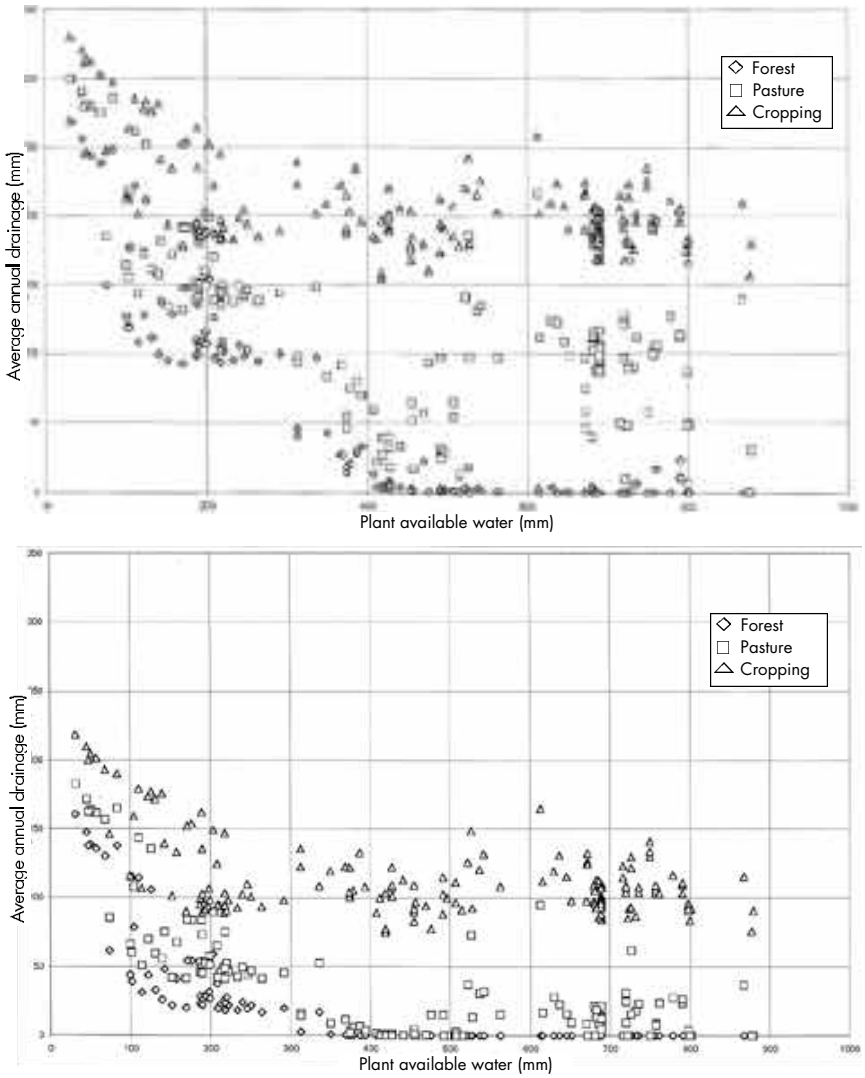

Figure 2.2 Estimated average annual drainage (mm) for 183 different soil types and 3 land uses. Graphs are presented for two areas of Mandagery Creek with average annual rainfalls of a) 650mm/year (top) and b) 810mm/yr (bottom)

- Drainage is highest for cropping and lowest for forest;
- Drainage is higher for the wetter area (*Fig 2.2b*) compared to the drier area (*Fig 2.2a*);
- Plant available water capacity to 4m has a large effect on predicted drainage; and
- Differences in drainage between land-uses become greater as plant available water increases.

Limitations and ways to tackle them

Naturally, there are some obvious limitations of the analyses undertaken so far. Some more obvious ones and the proposed methodology to address them are described in Table 2.1.

Preliminary findings

Although preliminary, these results are showing some interesting interactions between climate, soil type, land-use and drainage. Trends between average annual evapotranspiration and rainfall are consistent with earlier CRC for Catchment Hydrology work. As a result, we consider these results very promising. We also expect them to dramatically improve when combined with the outcomes from Tasks 2 and 4, which will provide relevant soil and climate seasonality indices that can be incorporated into the analyses.

Reference

Zhang L., Dawes W.R. and Walker G.R. (1999). Predicting the effect of vegetation changes on catchment average water balance. CRC for Catchment Hydrology Technical Report 99/12.

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WATER FORUM SEMINAR SERIES COMMENCES IN MELBOURNE!

PREDICTING POLLUTANT MOVEMENT FROM SOURCE TO SEA: A NEW REGIONAL WATER QUALITY MODEL TAILORED TO SOUTH-EAST QUEENSLAND.

Dr Rob Vertessy
CSIRO Land and Water
CRC for Catchment Hydrology

23 October 2001
5.00pm for 5.15pm

Sinclair Knight Merz
Auditorium
Ground Floor
590 Orrong Road
Armadale

Limited parking available on site. Otherwise please park in the surrounding streets and observe the relevant parking signs.

The Water Forum Seminar Series is a collaborative series between the five water-related CRCs: Catchment Hydrology, Coastal Zone, Freshwater Ecology, Waste Management and Pollution Control, and Water Quality and Treatment.

Seminars presented by Water Forum CRC staff will form a regular series in Melbourne, Canberra, Sydney and Brisbane.

For further information contact David Perry on 03 9905 9600

NEW WATER ALLOCATION RESEARCH REPORT

IRRIGATOR AND COMMUNITY ATTITUDES TO WATER ALLOCATION AND TRADING: A COMPARATIVE STUDY OF THE GOULBURN BROKEN AND FITZROY CATCHMENTS

by
John Tisdell
John Ward
Tony Grudzinski

Report 01/5

This new technical report details the findings of a comparative study of attitudes and opinions on water reform, allocation and trading between irrigators and community members in the Goulburn Broken (Vic) and Fitzroy (Qld) catchments.

The analysis provides insights to general opinion, and expectation of and blockages to, water reform in two eastern Australia catchments.

All of our publications can be ordered through the Centre Office.

PROGRAM 3
SUSTAINABLE WATER ALLOCATION

Program Leader
JOHN TISDELL

Report by John Ward

Project 3.2: Enhancement of the water market reform process: A socio economic analysis of guidelines and procedures for trading in mature water markets

The development of Australian water reform - a literature review

A review of the literature relevant to the development of Australian water reform was one of the primary first year milestones for Project 3.2. The scope and purpose of the review was to synthesise existing knowledge on trading in water entitlements, to explore synergies between water markets across Australia and to evaluate current water market activity, trading rules and market procedures. The report comprises of five chapters exploring the physical supply and nature of water, a history of water management in Australia and a summary of theoretical issues informing the debate on water management in Australia and throughout the world. Edward Elgar, an international scientific publishing house, is currently reviewing a draft of the report with the intention of international publication. This article is a brief synopsis of the literature review completed for Project 3.2.

Historical background

Water management in Australia has changed considerably with time, and particularly over the last twenty to thirty years. When making decisions concerning water supply, water authorities now need to consider not just hydrological and system constraints, but also the social, environmental and regional economic consequences of their decisions. COAG reforms have brought with them questions of economic efficiency and equity in managing a public good, not just better management of water supply systems.

For most of the first two hundred years of European settlement, water resource policies, like those relating to other resources, were focused on exploitation to promote economic and demographic growth, and employment generation. The role of the water authority was to engineer dams and supply systems to capture and promote the use of available water rather than plan or implement national or state economic or social policies.

Legislative and institutional arrangements

The relevant legislative arrangements in Australia date from 1886, and established the principle that streams were state property, administered by State controlled water agencies. A system of administrative allocation of rights to water was also instituted, managed by public water authorities in each State.

On the basis of these institutional arrangements, State governments became developers of water supply infrastructure such as dams, and developers and owners of large-scale urban and rural supply schemes (including irrigation).

Shift in broader aims

In the 1980s water management in Australia began to consider broader objectives. No longer do water authorities look solely to the construction of bigger dams to solve water issues; rather, they examine options of improving the allocation of existing water entitlements in conjunction with environmental and social policy objectives. Their objective is seen as promoting efficiency and equity of water allocation while protecting the environment.

Conflicting objectives – expansion versus optimal allocation

By 1990, water authorities were compelled to address issues and policies related to the management of water resources in a mature water economy. The incremental cost of water supply was sharply increasing. As most of the available and economic water resources had been exploited, and the cheap dam sites used, the opportunity cost of capital for water resource development had risen to historically high levels; an ageing infrastructure was contributing to increased operation and maintenance costs, and pressure for expenditure on replacement was increasing. Further, the demand for water resources was increasing in scale and diversity, particularly demand for environmental objectives, and concern for improved quality of supply. Conflict was growing, both between potential uses, and between the old developmental objectives and the newer economic and environmental objectives. These tensions were being played out within institutional settings geared to resource expansion rather than the optimal allocation of a scarce resource. Finally, awareness was growing of the severity of environmental degradation, its irreversibility in some cases, and the consequences including declining water quality.

The water authorities are now involved in managing these conflicting demands on the use and distribution of water within a period of institutional reform - be they economic, environmental or social. Meeting the broadening and changing role of water management in Australia will be among the greatest challenge facing water authorities in the future.

Summaries by chapter

Chapter 1 of the manuscript begins by outlining the nature of water resources, especially the relative volumes of useable water at a global and national level, and the increasing relative scarcity of water. In the backdrop of the physical characteristics of Australia's climatic characteristics and water resources, Chapter 2 then outlines the debate on the historical development of water management in Australia from early British common law to current national water reform agendas and international agreements.

Chapter 3 begins by pointing out the place of water reform within Australia's macroeconomic reform agenda. After outlining the history of microeconomic reform in Australia and its agenda to foster greater competition with the Australian economy, it explores the macroeconomic concerns leading to reform and the eventual establishment of the Council of Australian Governments (COAG) from which Australia's water reform agenda came. In doing so it outlines National Competition Policy and the Hilmer report and their links to the water reform agenda. The chapter concisely outlines the national competition policy on competition issues including regulatory restrictions on competition, structural reform, monopoly pricing, competitive neutrality and the public interest test. It also explores the links between COAG reform and associated tranche payments by the National Competition Council. It brings these together in an outline of the possible gains arising from the national competition policy. It concludes by briefly outlining the benefits and criticisms of the microeconomic reform agenda.

Chapter 4 explores in greater detail the implementation of the COAG reforms, National competition policy and National Competition Council tranche payments and overviews progress of implementation of the water reform agenda, specifically in water allocation and establishing water trading. The chapter decomposes and evaluates the implementation of water reform at a national, Murray Darling and state level (New South Wales, Queensland and Victoria), outlining the institutional and legal structures each have adopted in implementing the water reform agenda.

Finally, Chapter 5 summarizes current debate on the nature of water and the direction of water management on the basis of water being seen as an economic good. It begins by explaining the underlying theoretical economic assumptions of the water reform agenda and the axiomatic requirements for a functional, competitive market. A property rights approach has dominated the water reform agenda both nationally and internationally. It reviews the current opinion on the validity and potential application of that approach to water management at both levels.

Overview

The manuscript provides an overview of current debate and development of water reform in Australia. Over the last decade water management in Australia has undergone substantial changes. It began with an agenda of national development and drought proofing, associated with the use of a water resource perceived as ostensibly inexhaustible. The required hydrological solutions were focussed and efficiently executed; the impoundment, harnessing and distribution of water. Original riparian land and water rights were imported from England along with the notion that Australia was to be developed as an English social and agricultural clone. Based on Deakin's 1886 legislation, water rights have evolved into a complex system of water entitlements regulated by the state.

Next steps for water reform

The Council of Australian Governments, realising the need to address complex economic, social and environmental demands on water management, has implemented a water reform agenda which will require well defined property rights to water and the evolution of water markets. The task ahead is to develop and operationalise such rights and encourage immature water markets to evolve.

Catchword readers wishing to obtain a copy of the literature review will be advised how in a future issue.

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VICTORIAN FLOOD CONFERENCE

The next Victorian Flood Management Conference is being held in Traralgon from 10–12 October 2001. The conference, which is held only once every two years, is being hosted by the West Gippsland Catchment Management Authority and Latrobe City Council.

The theme for the conference, Planning for the Inevitable, is intended to highlight the importance of planning to good floodplain management.

If you would like to be placed on the mailing list for conference information, please contact the Chairman of the conference organising committee, Wayne Gilmour, on telephone (03) 5175 7800 or email wayneg@wgcma.vic.gov.au

NEW CRC REPORT

THE CALCULATION OF STREAMFLOW FROM MEASUREMENTS OF STAGE

by

John Fenton and Bob Keller

Report 01/6

This report is the key output from Project FL3, 'Hydraulic Derivation of Stream Rating Curves', part of the initial CRC's Flood Hydrology Program.

The main aims of the Project were to:

- To improve current methods of converting measured water levels to flow rates, especially for high flows; and
- Thereby to improve the reliability of flood estimates.

The report is divided into two main parts. The first part is a more descriptive presentation that is intended to be able to be read without it being necessary to refer to the second part, which consists of appendices providing technical details, as well as a presentation of the hydraulics of river flow.

Copies available from the Centre Office for $27.50

PROGRAM 4

URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Tony Wong

Report on visit to the United States of America

Introduction

During the 13 to 24 August 2001, I visited the United States of America to attend a United Engineering Foundation conference in Colorado. As part of this trip, I had the opportunity to visit a number of stormwater management project areas in the state of Maryland and Delaware and in Washington DC. I returned reassured that our research program is addressing much the same issues and that we are not "re-inventing the wheel". In fact there are some cases, particularly in relation to the integration of ecology into many of our research projects and in our use of risk-based approach to stormwater management, where I believe we are more advanced in our practice. This, of course, is not by accident as we have been able to learn from the good and, more importantly, the bad experiences of past practices in the United States in forming our thinking in stormwater management research and practices. The following is a brief report on my two weeks in the United States.

Stormwater Projects in Maryland and Delaware

A number of stormwater management projects in Maryland and Delaware were visited during 14 to 17 August, accompanied by Earl Shaver from the Auckland Regional Council in New Zealand. These States were amongst the first to commence their stormwater program in the late 1980s and early 1990s. Earl Shaver was instrumental in establishing the stormwater management programs for both states prior to his appointment as a technical specialist in the Auckland Regional Council's stormwater program. For me this visit was a continuation of a visit I made to Florida last year when I was hosted by Eric Livingston and had the opportunity to inspect a number of stormwater projects there. Many of the early design guidelines on wet detention ponds sand filters and vegetated swales were derived from experiences from projects in these three states.

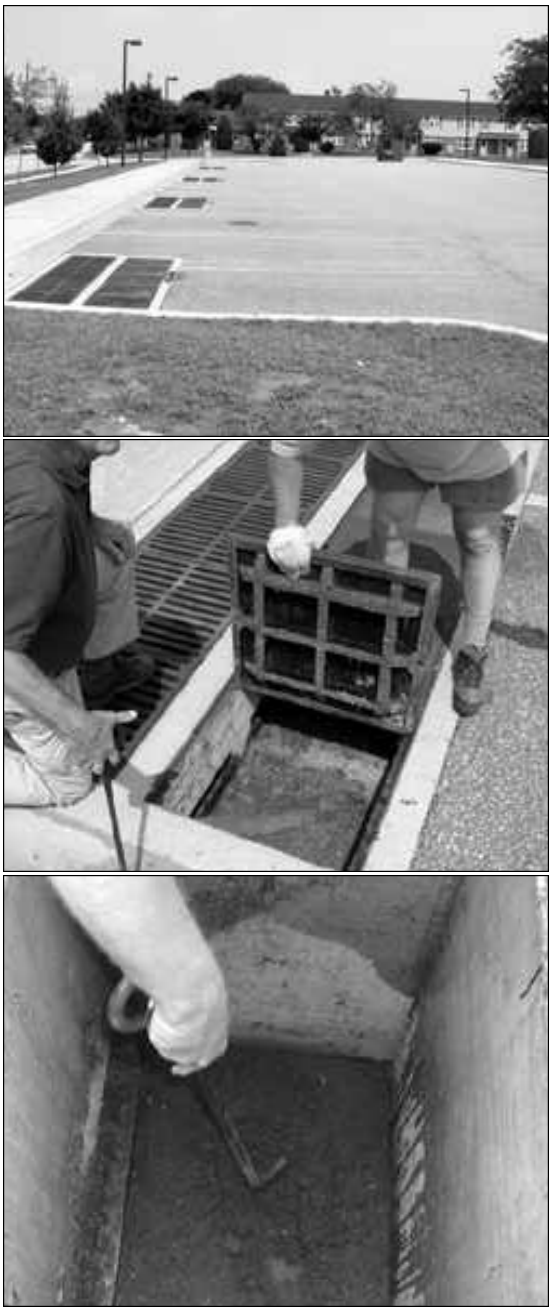

Figure 4.1 Below ground sand filters have been shown to be very effective in trapping grit and associated hydrocarbon – maintenance practice involves replacing of the top 50 to 75 mm of the sand every 3 to 4 years.

Sandfilters and wetlands

Stormwater management measures in Delaware and Maryland centred on the use of sand filters (see *Figure 4.1*) and wet detention ponds/constructed wetland systems. They feature prominently in the sites that I visited. There have been design modifications in these systems since the late 1980s, most notably the provision of high flow by-pass in constructed wetlands. There has been a greater emphasis on the provision for a wider range of wetland macrohyptes and the evolution of the below-ground sand filter system compared to the more landscaped "rain garden" (bioretention) system (see *Figure 4.2*).

Figure 4.2 A bioretention system (rain-garden) using a combined sand and organic mulch filter media for stormwater treatment in Prince George's County.

Figure 4.3 A car park design as a flood retarding basin (notice cross-fall of pavement) as well as for stormwater treatment through the bioretention median strips.

Figure 4.4 Sommerset Gardens, Prince George's County, Maryland – A Low Impact Development using a combination of grass swales and rain gardens for stormwater conveyance and treatment.

WATER SENSITIVE URBAN DESIGN

WATER SENSITIVE ROAD DESIGN - DESIGN OPTIONS FOR IMPROVING STORMWATER QUALITY OF ROAD RUNOFF

by

Tony Wong
Peter Breen
Sara Lloyd

Report 00/1

This joint publication with the CRC for Freshwater Ecology investigates opportunities for incorporating stormwater quality improvement measures into road design practices for protecting aquatic ecosystems.

Copies of the report are available from the Centre Office for $27.50 (includes postage and GST).

Please phone Virginia Verrelli on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

Low impact development projects

Low Impact Development (equivalent to Water Sensitive Urban Design as we know it) is now being considered by a number of organisations in the United States most notably some officers in the US-EPA Prince George's County in Maryland and the City of Portland in Oregon. A number of these Low Impact Development projects that I visited included:

- a recent shopping centre project in Prince George's County where the combined use of a car park for flood detention and stormwater treatment through the use of bioretention systems build on median strips (see *Figure 4.3*) was adopted; and
- a residential development at Somerset Garden which utilised a combination of grass swales and rain gardens in place of the conventional stormwater drainage system (*Figure 4.4*).

Most of the projects do not have monitoring data. The anecdotal evidences of the sand filter and bioretention system suggest that these systems are performing well. A recent laboratory investigation of the performance of bioretention systems by Davis *et al.* (2001) from the University of Maryland has reported reductions in copper, lead and zinc concentrations attributed to the soil-mulch-plant-based system of over 90%. Corresponding reductions of phosphorus, TKN and ammonia reported are 80%, 65% to 75% and 60% to 80% respectively.

The United Engineering Foundation Conference

The UEF conference was held in Snowmass, Colorado between 19 August and 24 August. The theme of the conference was "Linking Stormwater Best Management Practice Designs and Performance to Receiving Water Impacts Mitigation", the theme arising from a recognition that current practices in the United Sates (and probably elsewhere) have not linked measures of aquatic ecosystem health to the design and management objectives of stormwater Best Management Practices. I was one of two Australian attending the conference.

Australia versus US approaches

Ian Lawrence (CRC for Freshwater Ecology) presented an excellent overview of Australian urban stormwater management practices, contrasting the litigious and regulatory approach adopted in the United States with a broader regulatory/government-industry partnering ethos in Australian practice.

In my opinion, the reliance on a strong regulatory driver to change stormwater management practices has meant that many of the regulations have to be prescriptive, often "diluting" their scientific basis to facilitate simplicity in enforcement. Furthermore, the linkage to the primary objectives associated with impact mitigation of the receiving waters ecosystem is often not apparent with a highly prescriptive driver for improved urban stormwater management.

It was interesting to note that there have been some moves to legislate a "zero pollutant discharge" rule (perhaps a remnant of the point source or wastewater discharge control policy) by one particular city as part of its policy – a near impossible task when we consider that stormwater flow and pollutant loadings are inherently highly variable.

Factors influencing aquatic ecosystems

Many of the issues raised at the conference relate to the recognition that aquatic ecosystem health is influenced by many factors. Our appreciation of these influencing factors and management options are well-established and they have formed the basis of our collaborative research efforts with the CRC for Freshwater Ecology in Program 4 and Ian Rutherfurd's Program 6. Many of the factors influencing aquatic ecosystem health are explained in Peter Breen's chapter on "Ecosystem Health – Definition and Assessment" in our report on Water Sensitive Road Design (CRC Technical Report 00/1).

Conference outcomes

The conference concluded that there is a need for a more integrated planning of land and water management options and the development of stormwater management infrastructure for multiple objectives. Furthermore, the conference concluded that there is a need to adopt a risk-based approach to the design of stormwater management measures and that a continuous simulation approach be adopted in the design process.

MUSIC

I also had the opportunity to demonstrate the application of MUSIC (Model for Urban Stormwater Improvement Conceptualisation) as a planning/decision support tool in facilitating an integrated catchment approach to urban stormwater management. This was very well-received and generated a fair deal of enthusiasm. MUSIC supports a continuous simulation approach in evaluating the individual, and collective, performance of stormwater management measures in pollution reduction. It is seen by many as the type of tool necessary to support the direction in which the conference concluded stormwater management practices in the United States need to go to in order to incorporate an integrated catchment approach to stormwater management and to improve the linkage between stormwater management and ecosystem health

protection. Copies of the beta-version of MUSIC were left with the US-EPA, Engineering Department of Prince George's County, University of Colorado and Tectra Tech Consulting Engineers for their evaluation.

Conclusions from trip

As mentioned in my introduction, I returned from my trip to the United States reassured that our research program are well-founded, and that we are addressing issues which are now emerging in the United States.

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Reference

Davis, A P, Shokouhian, M, Sharma, H and Minami, C (2001), Laboratory Study of Biological Retention for Urban Stormwater Management, Water Environment Research, Vol.73 No.1, pp5-14.

CONFERENCE PROCEEDINGS

THE THIRD AUSTRALIAN STREAM MANAGEMENT CONFERENCE - THE VALUE OF HEALTHY STREAMS

27-29 August 2001

Brisbane, Queensland

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Note: Limited copies of the Second Australian Stream Management Conference ($104.50 including GST and postage) are also available.

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PROGRAM 5

CLIMATE VARIABILITY

Program Leader
TOM McMAHON

Report by Alan Seed

The Simulation of 1 in 5 Year ARI Design Storms for Melbourne

EPA regulations on sewage overflows

Under the State Environment Protection Policy (Waters of Victoria) Melbourne Water must progressively upgrade the sewerage transfer system to contain flows resulting from a 1 in 5 year ARI storm event. At present the design storm hyetograph is generated using the standard Australian Rainfall and Runoff (AR&R) method of first estimating the 1 in 5 year storm total using rain gauge data, applying an areal reduction factor to convert the point measurement into an equivalent areal measurement over the 1600 km^2 catchment, and then distributing the storm total in 5-minute time steps using a standard temporal pattern.

Melbourne Water modelling

Melbourne Water has developed a spatially distributed model to simulate both the infiltration of stormwater into the sewers and the operation of the various components of the system. Melbourne Water's comprehensive sewage flow monitoring at key locations in the system and rain gauge network throughout metropolitan Melbourne are used to collect calibration and validation data for the model. The AR&R storms are used with the calibrated model to simulate the system response to a design storm, and hence determine predicted flows at critical locations. Possible limitations are that the AR&R design rainfall pattern is uniform over the entire network possibly leading to higher estimates of pipe flow, and secondly the issue that only one design storm scenario can be generated.

CRC space and time model

The CRC for Catchment Hydrology (CRCCH) has developed the space and time design storm model *Motivate* that can be used to generate plausible rainfields for storms with a known Annual Recurrence Interval (ARI). Motivate requires the gross statistics for the event (duration, mean intensity, variance at the small and large scale, and advection velocity) and scaling descriptors that control the space and time correlation structure of the field. The mean intensity for a given duration of the design storm is estimated using rain gauge records in the usual manner.The scaling parameters, variance of the rain field, and advection velocity are estimated using radar data.

Modelling 24-hour storms

The objective of the study reported here was to use Motivate is to develop the capacity to generate or simulate a number of 24-hour storms, each with a 1 in 5 year ARI, that are representative of "typical" Melbourne rainfall. These storms were then routed through the hydrological model so as to estimate the sewerage system's response to variability in the small-scale details embedded within a design storm as modelled by Motivate, and so overcome the two major problems with the present approach.

Melbourne rainfall data

Melbourne Water has operated a 45-gauge network of rain gauge in the Greater Melbourne area over the past 20 years. 6-minute data from the network were used to estimate a time series of mean areal rainfall which was then used to estimate the 1 in 2, 5, and 10-year ARI values for seven durations ranging from 30 minutes to 72 hours. The use of an areal reduction factor to scale a point statistic to an areal statistic was thereby avoided.

An understanding of the meteorology of events that cause significant infiltration into the sewer network is required so that the 8-year radar record can be searched for a library of events that have similar meteorological characteristics. The gauge data were used to identify storms that had 24-hour mean areal rainfall accumulations that were close to 50 mm; the 1 in 5 ARI. The 58 events identified as being within ± 10% of the 5 year ARI depth for the 7 durations were examined subjectively for independence and, using a synoptic timescale (~24 hours) as a measure of independence, the set was reduced to 24 synoptic situations. The Mean Sea Level Australian Region meteorological analyses for these occasions were obtained from Bureau of Meteorology archives and examined to identify six characteristic storm types. Many storms generated significant accumulations over a number of durations, for example the 21/11/88 storm was significant over all durations from 1 to 36 hours. The largest storm in the record and 5 out of the 15 cases that produced storms with durations that exceeded 12 h were classified as cut-off low situations, where a closed cold core "low" becomes completely removed from the mid-latitude westerlies and generates rainfall embedded in a south-westerly to westerly air flow.

Using significant storms in radar record

Unfortunately, the archive of radar data for Melbourne provides a detailed history of the driest five-year spell on record, and therefore only three significant storms in the radar data (in 1993, 1994, and 1999) were identified. The 10/2/94 storm produced significant rainfalls for all durations between 6 and 36 hours and is the largest storm in the radar record to date. The 26/12/1999 event was classified as an easterly dip, where isobars associated with the easterlies to the north dip southwards bringing warm moist air from the tropics into the mid latitudes causing convective rainfall. The rain field was particularly slow-moving with a speed approximately half that of the other two cases. This together with the convective nature of the rainfall resulted in accumulations with highly localised maxima. The 24-hour accumulations at some gauges exceed the 1 in 20 year ARI, whereas the ARI for the mean areal rainfall was only about 1 in 5 years. Because these small-scale elements exceeded the design standard, it was decided not to include this storm in the simulations of the sewer system.

Estimating speed and direction of rain fields

The radar data were used to estimate the speed and direction of the rain fields, as well as the scaling parameters required for the Motivate model.The simulations were then validated by comparing the spatial and temporal correlation functions for the radar and simulated data over a range of accumulations. The point statistics were validated by comparing the hourly synthetic statistics for pixels at the gauge locations with the rain gauge statistics.

Applying design storms – main conclusions

An ensemble of 20 design storms, 10 from each of the two storms analysed, was generated and each storm was routed through the hydrological model. The results show that the design storms generated flows that exceeded the flow generated by the AR&R storm on 7 out of the 20 occasions at the Western Treatment Plant and only once at the Eastern Treatment Plant. The range of the flow volumes at the two outfalls generated by the 20 storms was quite similar and varied by less than ±10%. Therefore, the large-scale runoff volumes are quite insensitive to small-scale details in the rain field.

The spill volumes for small sub-catchments varies dramatically between simulations due to the spatial variability of the rainfall. The realistic storms produced spill volumes on the small scale that exceeded the AR&R storm 20% of the time. The median spill volume from the 20 simulations was substantially less than the AR&R volume. Therefore, if AR&R is used as the basis of the design, the probability of a spill in a small sub-catchment given a 1 in 5 y storm at the basin scale is about 20%.

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NEW WORKING DOCUMENT

MODELLING VICTORIAN ANNUAL RAINFALL DATA

by

Ratnasingham Srikanthan,
Tom McMahon,
Mark Thyer and
George Kuczera

Working Document 01/1

This report represents a milestone in the Climate Variability Research Program led by Tom McMahon.

Copies of this working document are available through the Centre Office for $22.00 including GST and postage.

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PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Ian Rutherfurd

Third Australian Stream Management Conference

Background

From August 27th to 29th nearly 400 stream researchers and managers met in Brisbane for the Third Australian Stream Management Conference (3ASM). In this brief review of the conference I wanted to touch on the role that the CRC for Catchment Hydrology played in the event, and to note that the trends evident in the stream management industry have implications for the Centre.

The overall theme of 3ASM was "The value of healthy streams", and the conference was deliberately focussed on the science and economics of stream management, at the expense of community management and institutional arrangements (these issues were emphasised in the Second Stream Management Conference held in Adelaide in 1999).

The four sub-themes were:

- Ecosystem services provided by streams
- Biophysical interactions in streams
- Hydrological connectivity (along streams, in the stream bed, and onto floodplains), and
- Tools and techniques for stream management.

Observations

Here are some observations that we have made from the more than one hundred papers published in the proceedings. Here are some observations of the conference material.

There is no doubt that stream management and stream rehabilitation in Australia is a burgeoning area of endeavour. We are seeing a broadening and deepening of the research and on-ground works that are being carried out. Stream management is increasingly being justified on environmental and ecological grounds alone. Stream work no longer has to be justified on the grounds that it will protect infrastructure and economic assets. We are now seeing that the ecosystem services provided by healthy streams are often justification enough to maintain and improve stream condition. A major area of endeavour for the industry is to address more clearly the 'value' of stream systems in terms of conservation values. This underpins most of the management work, but is as yet poorly understood.

There is some progress in integrating the physical and biological dimensions of stream and catchment work. This was well demonstrated in the joint CRCs 'source to sea' session at the conference, as well as the SE Queensland session, in which research was integrated across large areas. The CRC for Catchment Hydrology is at the vanguard of this catchment scale integration, and I, for one, am convinced that the catchment scale focus of our centre will pay off in the longer term. The results of the National Audit work are already being felt in terms of policy directions.

Although we can congratulate ourselves about the growing integration between the disciplines (especially biology, engineering, geomorphology, economics and sociology). Dr Phil Price (Land and Water Australia) made some closing comments to a plenary session suggesting that there is still a long way to go in the area of integration and truly multi-disciplinary projects. He would argue that there are precious few such projects in Australia.

It is exciting to see so many tools being developed to assist in stream management.These range from conceptual procedures, through to on-ground methods. The CRC for Catchment Hydrology is involved in developing many of these tools. Most of the tools, however, remain as ideas, and their effectiveness still has to be demonstrated. Similarly, many rehabilitation projects are being started, but it will be many years before their effectiveness can be demonstrated. We look forward to future conferences where we can see convincing evaluation of both tools and entire projects.

Scientists from our CRC were well represented at the conference, but also in the papers in the proceedings. The CRC for Catchment Hydrology was also a major sponsor of the conference. We developed the web site for the conference (many thanks to Daniel Figucio for this), as well as organising the conference proceedings. Having the 120 papers from the conference reviewed and published before the conference has been a great achievement and a credit to our CRC. In particular I would like to acknowledge the fantastic work done by that engine of transfer and adoption, David Perry, who was involved in all aspects of the event. I would also like to thank Chris Kenyon who worked tirelessly organising the conference papers. We used a web based intranet site for this task – with mixed results!

Finally I would like to thank John Amprimo of the Queensland Department of Natural Resources and Mines, who tirelessly coordinated the conference. 4ASM will probably be in Tasmania in mid to late 2003. No doubt the CRC for Catchment Hydrology will again make a major contribution to this conference.

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PROGRAM 7 — Program Leader

COMMUNICATION AND ADOPTION

DAVID PERRY

The Flow on Effect – September 2001

Christmas may seem some time away, but I can sense the inevitable rush towards the end of the year already. There is plenty happening both in the CRC and in other related organisations. I have highlighted some recent CRC publications in *Catchword* this month, but there's a lot more information on-line at www.catchment.crc.org.au/ under 'news' and 'events'.

Third Australian Stream Management Conference

During August in Brisbane, scientists and managers from every state and territory met at the Third Australian Stream Management Conference. The success of the event was reflected in the attendance of over 400 participants. The CRC for Catchment Hydrology was well represented at the conference, with many papers highlighting our contribution to the industry (see Program 6 report for more detail).

How to obtain the proceedings

Over 120 papers from the conference are published in the two volumes of proceedings. The set of proceedings cost $110.00 (including GST and postage in Australia) and are available through the Centre Office (see back page of this issue) or through the Australian Stream Management Conference website at www.catchment.crc.org.au/streamconference. The website gives a table of contents from the proceedings for those who would like to review the range of papers presented. [We also have a few copies of the Second Australian Stream Management Conference proceedings as well (these are $104.50 per copy)].

Thank you

A special thanks to the editors of the proceedings: Ian Rutherfurd (The University of Melbourne), Fran Sheldon (Griffith University), Gary Brierly (Macquarie University) and Chris Kenyon (The University of Melbourne). Thanks also to all of the CRC staff who contributed to this great event. I understand from a reliable source that the next one will be in Tasmania in 2003!

Three new CRC Reports

A number of CRC publications are expected to be ready for distribution by the time you receive your *Catchword* and there are many more in the pipeline. *Catchword* readers registered on our events database automatically receive an email notice when a new report in their areas of interest is published. To receive this service visit www.catchment.crc.org.au/subscribe

These new reports are:

- *The Calculation of Streamflow From Measurements of Stage*

  The CRC Report 01/6 entitled 'The Calculation of Streamflow from Measurements of Stage' is by John Fenton (The University of Melbourne) and Bob Keller (Monash University). The report is a key output from Project FL3, 'Hydraulic Derivation of Stream Rating Curves', part of the initial CRC's Flood Hydrology Program.

  The main aims of the Project were to:
  - To improve current methods of converting measured water levels to flow rates, especially for high flows; and
  - Thereby to improve the reliability of flood estimates.

  The report has two main parts:
  - A descriptive stand-alone presentation; and
  - Appendices providing technical details, as well as a presentation of the hydraulics of river flow.

- *Implementation of a Mean Annual Water Balance Model within a GIS framework and Application to the Murray-Darling Basin*

  CRC Report 01/8 entitled 'Implementation of a Mean Annual Water Balance Model within a GIS framework and Application to the Murray-Darling Basin' is by Andrew Bradford, Lu Zhang and Peter Hairsine (CSIRO Land and Water) describes the implementation of a simple water balance model in a GIS (Geographic Information System) framework for assessing average annual streamflows (water yield) under different land-use scenarios in the Murray-Darling Basin. The model requires only catchment percentage forest cover and mean annual rainfall. The report describes the water balance model, its input data and the process required to prepare those data.

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- *Irrigator and Community Attitudes to Water Allocation and Trading: A Comparative Study of the Goulburn Broken and Fitzroy Catchment*

  CRC Report 01/5 entitled 'Irrigator and Community Attitudes to Water Allocation and Trading: A Comparative Study of the Goulburn Broken and Fitzroy Catchment' is by John Tisdell, John Ward and Tony Grudzinsky (Griffith University). It details the findings of a comparative study of attitudes and opinions on water reform, allocation and trading between irrigators and community members in the Goulburn Broken (Vic) and Fitzroy (Qld) catchments. While these catchments have quite different climate, hydrology, farming practices and social characteristics, water managers in both catchments have to meet national water reform policy objectives. The analysis provides insights to general opinion, and expectation of and blockages to, water reform in two eastern Australia catchments.

All of our publications can be ordered through the Centre Office. For further information contact Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

www.catchment.crc.org.au/publications

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POSTGRADUATES AND THEIR PROJECTS

Our postgraduate for September is:

Linh Nguyen

Background

My university studies began with a Bachelor's degree in Forestry which I completed back home in Vietnam in May 1997. After that I worked as a researcher in the Center of Natural Resources and Environmental Studies (CRES), Hanoi National University, for six months. This was followed by a scholarship funded by World Wildlife Fund (WWF) for a masters degree in the United States. I finished the masters program in the U.S. and returned home in December 1999 working then with the Vietnam Sweden Mountain Rural Development Program (MRDP) as a technical assistant focusing on GIS, database management and forestry. During my time in the U.S., I studied at Oregon State University in the Department of Geosciences. My major study was in Geographic Techniques, and a minor in Resource Geography. My research interests are GIS, remote sensing, spatial modelling, watershed modelling and management, landscape ecology and statistics.

I arrived Melbourne in September 2000 to start my PhD in Hydrology at The University of Melbourne. My supervisors are Assoc. Prof. Rodger Grayson, Drs. Rob Vertessy and Alex Held. My thesis title is 'Elucidating catchment behaviour using multi-temporal high resolution remote sensing data'.

Motivation for my research:

Physically-based, spatially-distributed models have been widely used in simulating spatial and temporal hydrological processes at different scales and have gained significant success in hydrological research. However methods used for model validation are commonly solely based on comparisons between predicted and observed stream flows at the outlet since often this is only data available. Data are generously insufficient for proper model testing.

A major problem with distributed models has been that different process descriptions often result in very similar outflow hydrographs. The use of patterns to validate internal model predictions should significantly reduce this problem. Satellite data with characteristics of high frequency and large spatial coverage can provide a useful source of information for assessing model performance by testing models' internal states. Patterns of spatial and temporal variability of vegetation and surface temperature derived from remote sensing data can be used to provide information for testing water balance or coupled water and energy balance models at range of scales.

Remote sensing data can also be used to characterise structured variability of catchment characteristics such as spatial autocorrelation and spatial connectivity, which significantly affects catchment hydrological response. Methods for representing the structured variability over the catchment are also useful for interpolating areal values of characteristics from point measurements. My work is aimed at developing representations of structured variability in vegetation cover as a temporal integrator of soil moisture availability for use in testing spatially distributed models. The work is associated with Project 1.2: 'Scaling Procedures to Support Process-Based Modelling at Large Scales' and Project 2.3: 'Predicting the Effect of Land-use Changes on Catchment Water Yield and Stream Salinity'.

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WEB SEARCH ENGINE UPGRADED

The CRC's website search engine has recently been upgraded and is now able to search Adobe pdf files.

Over 2000 people seeking information on aspects of catchment hydrology visit the our site each month.

www.catchment.crc.org.au

CRC PROFILE

Our CRC Profile for September is:

CRC Project Leader, Dr Tony Ladson, The University of Melbourne

What are you listening to?
Watermark by Enya.

What are you reading?
I've just started "Seeing things whole: the essential John Wesley Powell" by William deBuys. In 1869, John Wesley Powell, a one-armed civil war veteran, was the first person to raft the Colorado River and explored much of the desert country of Arizona and Utah. He invented the field of geomorphology and employed G. K. Gilbert (another famous geomorphologist) as his assistant.

Powell thought it was important to manage streams along with their catchments. He argued that local government boundaries should correspond to catchment boundaries so the interlocking interests of the community would mean land, forests and water would be looked after. Powell would probably have thought that Catchment Management Authorities in Victoria were a good start.

Who would you most like to meet?
Sir Ronald East. He oversaw the construction of most of the dams on Victorian Rivers and on the Murray and most of the irrigation systems in Victoria. I'd like to ask him if he thought it was worthwhile.

What talent do you wish you had?
I'd like to be able to write faster.

What are you angry about?
In Victoria, I don't think we are doing a good job with water allocation.

What are you exultant about?
Um, this isn't water related, but...my wife is having a baby in two weeks.

What river would you most like to visit?
The Nile River, especially the Sudd region on the White Nile in Sudan.

What is your favourite film?
Chinatown, water politics changes the face of Los Angeles (unfortunately the good guys don't win).

What CRC projects are you working on?
I'm working with Ian Rutherfurd in the River Restoration Program and have three main projects. Project 6.2 is looking at urban streams where we have a cooperative project with CRC for Freshwater Ecology and Melbourne Water. We plan to change the flow in an urban stream – make it more natural – and see if the biota improves i.e. becomes more like that in a rural stream. We are planning to change the flow by retrofitting a retarding basin so that small floods are attenuated - perhaps improving the hydraulic conditions for the bugs. We will also look at the implications for urban stream restoration planning based on the outcomes of this experiment, along with other work.

Project 6.6 is about scour or erosion. Sometimes in stream restoration we want to cause scour, for example, to improve fish habitat; sometimes we want to control it. This project is researching tools and techniques to manage and predict erosion.

I'm also the principal investigator of a project to develop an Australian Handbook of Stream Roughness Coefficients. We are planning a web-based approach rather than a book and will be inviting people and agencies around Australia to contribute information on flow resistance where they are confident it is accurate and don't mind sharing it with others.

I'm also doing work on soil moisture with Rodger Grayson. In this project we are gathering actual measurements of the maximum amount of water that can be stored in a soil; an important parameter for hydrologic and weather prediction models.

Do you have any non-CRC projects?
Between August 2000 and June 2001 I had a Victorian Fellowship, which allowed me to travel to the US and South Africa to investigate adaptive management of environmental flows, and am now writing up what I learned.

The most interesting cases were the Columbia, Mississippi and Colorado, where, just like in the Murray-Darling Basin, human demands on these rivers are degrading their environmental condition. There just isn't enough water to keep everyone happy and we need better systems to ration it, either market-based, or some other approach, that takes proper account of non-production values. This is a big change from the ideas of development that dominated until about 1980, and I think we are still struggling with these new arrangements.

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WHERE ARE THEY NOW?

Report by Tam Hoang

It seems like I am coming back to the past as I sit in front of my computer, tapping on the keyboard on a Saturday afternoon. A few months have passed since the submission of my thesis – the same period when I finally said goodbye to those seemingly never-ending weekends spent writing up the thesis. However, as life is full of unexpected events, it is not surprising to find me returning to the previous habit – working again on weekends – to write these lines for *Catchword*. I suddenly wish to hear a 'welcome-back' from my former companions: computer, desk, chair, books, and even my bookshelf.

For those who do not know me, I am a civil engineer from Vietnam, who migrated to Australia at the end of 1991. Due to a recession in the Australian economy at that time, I was unable to find a job in my chosen profession. Therefore, I decided to go back to university to obtain more skills and appropriate knowledge in order to be able to start my working life all over again.

After graduating from RMIT at the end of 1995 with a Bachelor's Degree in Civil Engineering, I continued at Monash University as a postgraduate student in the Department of Civil Engineering. The topic of my research was "a joint probability model for rainfall-based design flood estimation". The objective of this study was to develop and test a new model for estimating design floods from design rainfalls, taking into account the joint probability and interactions of key flood producing factors. My work was supervised by Mr. Erwin Weinmann and Emeritus Professor Eric Laurenson.

In late July 1999, when I had completed about 75% of the first draft of my PhD thesis, I came across an advertisement by the Bureau of Meteorology (Melbourne) for staff of the GTSMR (Generalised Tropical Storm Method Revision) project. Taking the advice of my co-supervisor, I applied for the position to get some practical experience. I then transferred from full-time to part-time study and have been with the Bureau since then.

Many warn that writing a thesis while holding down a full-time job is very difficult. I experienced to the fullest what this really means! However, I have been very fortunate to work at the Bureau because they have a flexible working hours scheme, and I also have a very kind boss who allowed me to devote a day every fortnight to work on my thesis. Writing only during my flextime and over some free hours on weekends, I finally completed my thesis and submitted it in May this year. I then took my annual leave to spend a month's holiday in Vietnam with my family.

The project I have been working on at the Bureau aims to estimate probable maximum precipitation (PMP) for areas affected by tropical storms in Australia. These areas include Queensland, Northern Territory, most of Western Australia, and the northern parts of New South Wales and South Australia. After some initial testing, the method we adopted is the same as that applied in the Generalised Southeast Australia Method (GSAM) for PMP estimates for South-East Australia. According to this method, a storm can be generalised by removing its storm-specific features due to variability in moisture inflow between storms, and site-specific influences caused by topography and variances in maximum moisture content for different locations. The PMP is determined from the envelope curves of the generalised storm database.

Working at the Bureau is very enjoyable. In my case, I guess one of the best aspects of work is to be able to make a living, and at the same time, enjoy my job. By working with tropical storm data observed at various locations in Australia, my knowledge of Australian geography is increasing all of the time. Together with technical skills, my communication skills are improving significantly. I am now also much more familiar with the expressions (that I never learnt at school) used by my colleagues, such as arvo, tucker, dodgy, fair dinkum, woop woop, crack the whip or spit the dummy!

Well, as our project is coming to a close, I am now looking for opportunities to further practise my new skills and also expand on them. Meanwhile, I have been enjoying every minute of life and the pleasure of being able to do whatever I wish on my completely relaxing weekends.

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PP338685/00026

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OUR MISSION

To deliver to resource managers the capability to assess the hydrologic impact of land-use and water-management decisions at whole-of-catchment scale.

OUR RESEARCH

To achieve our mission the CRC has six multi-disciplinary research programs:

- Predicting catchment behaviour
- Land-use impacts on rivers
- Sustainable water allocation
- Urban stormwater quality
- Climate variability
- River restoration

CRC AUSTRALIA

The Cooperative Research Centre for Catchment Hydrology is a cooperative venture formed under the Commonwealth CRC Program between:

Brisbane City Council
Bureau of Meteorology
CSIRO Land and Water
Department of Land and Water Conservation, NSW
Department of Natural Resources and Environment, Vic
Goulburn-Murray Water
Griffith University
Melbourne Water
Monash University
Murray-Darling Basin Commission
Natural Resources and Mines, Qld
Southern Rural Water
The University of Melbourne
Wimmera Mallee Water

Associates: SA Water • State Forests of NSW