NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 90 DECEMBER 2000

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

Inside...

SEASONS GREETINGS *On behalf of the CRC for Catchment Hydrology, I wish Catchword readers a safe and happy Xmas, and a satisfying new year.*

Research program overview

This month's note completes the series (March, April, June, and August 2000 issues) outlining the CRC's research programs and their linking together to form an integrated set. The purpose of these articles is to show how each program contributes to the main goal - predictive capability for water, sediment, solute, and nutrient movement at catchment scale. (Note: This integration extends to and encompasses the Programs for Communication and Adoption, and Education and Training; they are equally important to the overall goals of the CRC.)

Figure 1 shows the basic concept – that the drivers of catchment response are climate and land use. The response to these gives rise to impacts, which (if understood) can be managed. This is a central concept in the CRC's mission: to deliver to water resource managers the capability to assess the hydrologic impact of land-use and management decisions at whole-of-catchment scale.

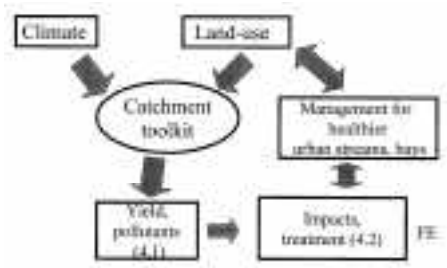

Figure 1. Basic concepts involved in the catchment approach

The CRC Programs featured in this article are River Restoration and Urban Stormwater Quality.

River Restoration Program

Streams can be considered an integrator of what happens on catchments - the flows which stem from the rainfall (after losses from evaporation, transpiration, water diversions for irrigation and town supply, storage in reservoirs, etc) are those which shape stream morphology and river habitat. Similarly, the entrainment of sediment and solutes is a major influence on stream water quality.

The management of catchment land-use is a key to achieving healthier rivers, as shown in *Figures 2*. It also indicates the importance of a total catchment approach to river restoration, and the involvement/links to the CRCs for Freshwater Ecology (FE) and Coastal Zone (CZ). Linkages to our Program 2: Land-use Impacts on Rivers, are particularly strong.

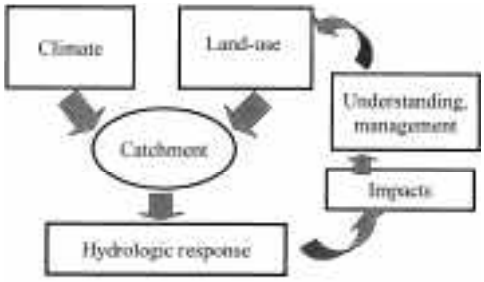

Figure 2. Showing how River Restoration fits with the catchment scale approach

The projects in the River Restoration Program cover a range of activities:

- stream restoration procedures and evaluation (including impacts of riparian vegetation)
- performance of fish-ways
- tools to predict scour of rehabilitation works.

Several, including a restoration ecology project and an environmental flows project, involve joint research with the CRC for Freshwater Ecology.

Urban stormwater runoff

Urban catchments have much in common with their rural counterparts. Both have hydrologic responses dominated by climate and land-use. The urban catchment relationships (*Figure 3*) are therefore similar to the rural ones shown in *Figure 2*. The nature of hydrologic impacts from urbanisation is certainly different from rural, as are the pollutants which stem from urban areas. The CRC's Urban Stormwater Quality Program focuses particularly on the urban pollutants as part of the larger strategy for healthier urban streams and bays.

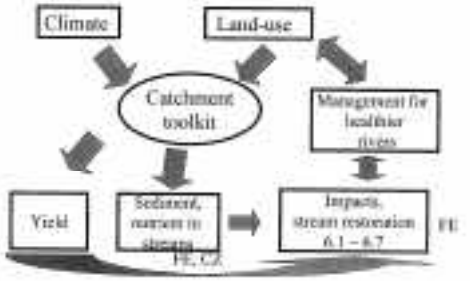

Figure 3. Showing the total catchment approach being taken for the Urban Stormwater Quality Program

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For the urban work, the emphasis of the CRC is again for predictive capability at catchment scale. A Stormwater Quality Management Toolkit is proposed, based on a set of models for a number of water quality and quantity components. The toolkit will be in the form of a decision support system (DSS), with software to enable managers to design stormwater systems that reduce the current pollutant levels typical of urban runoff. Linkages to other programs in the CRC are strong, with the strongest being to the Climate Variability and Predicting Catchment Behaviour Programs. Some joint work with the CRC for Freshwater Ecology is involved.

The two projects in the Urban Stormwater Program are linked. Project 4.1 is primarily the development of the DSS; Project 4.2 mainly deals with the data and improved understanding needed for building and evaluating the DSS.

Overall

Both the River Restoration and Urban Stormwater Quality Programs are consistent with the CRC's aim to take a catchment scale approach. Both are integrated closely with other Programs in the CRC, and with the CRC for Freshwater Ecology. Collaborative effort is a major ingredient and we believe we can provide it.

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PROGRAM 1
PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Susan Cuddy

Integrated Catchment Management System (ICMS)

The ICMS software was introduced to you in the June issue of *Catchword*. It is a PC-based product to aid rapid delivery of research results to catchment managers. While developed within CSIRO Land and Water as part of a LWRRDC-funded project, it fits well within the CRC for Catchment Hydrology's "Modelling Toolkit" project (Project 1.1) as it is aimed at delivery of environmental decision support systems (DSSs).

Perth Workshop

This article reports on the outcomes of an ICMS workshop held in Perth on 24 November 2000 to staff of the WA Department of Agriculture, and the Water and Rivers Commission. The workshop was on the model building component of ICMS, namely ICMSBuilder. Other components, which build DSS functionality, are still under development.

- Purpose

The purpose of the workshop was three-fold:

- to expand the group of people exposed to the ICMS approach to developing and building models
- to gauge the receptiveness of WA catchment management agencies to using ICMS to assist them build environmental models and DSS
- to promote the concepts of a more structured approach to model encapsulation, in line with the objectives of CRC Project 1.1.

A flier for the workshop was distributed by colleagues within the Department of Agriculture to groups working in catchment management. Thirty people took up the offer.

The day was split into two sessions: an overview session, followed by a four-hour hands-on workshop, structured around a set of tutorials.

- Overview

The overview was presented by Susan Cuddy and Michael Reed of CSIRO Land and Water, and Dr Barry Croke of the Integrated Catchment Assessment and Management (ICAM) Centre, Australian National University. Participants in the workshop, which was run as a hands-on practical session, were supported by the presenters and three PhD students who have been using ICMS to support the

development and implementation of their theses (see References).

- Participants

The audience ranged from experienced programmers to managers with no programming expertise. Nearly all attempted the four tutorials which were sequentially structured to:

- build an application comprising one object (a subcatchment) and one (very simple) model associated with that object
- link subcatchment objects and transfer data from one subcatchment to another (this required small changes to the model)
- build and link in a flow routing model to pass data from one subcatchment to another
- build a spatially and temporally dynamic model for routing water over a surface using time series data.

By this stage, some users were running models and visualising data. For the advanced user, a fifth tutorial challenged them to build the 'game of life', a cellular automata model.

Observations from workshop

Three observations from the workshop are very important to directing the products we develop.

The first is that, while there may be a body of modellers and programmers who revel in writing code to format, transform, and view their data and modelled predictions, there is an even larger body of 'para-modellers', with limited programming expertise, who are desperate for good tools to do this for them. It is difficult for agency staff to be knowledgeable about and have access to software that supports their catchment management needs.

The second is that the concept of reducing models into reusable modules which are easily distributed and able to be linked in a plug-and-play fashion to suit the problem at hand is very attractive and desirable.

The third is more to do with how people traditionally approach model development - and the design of the first tutorial. The ICMS approach is based on the object-oriented approach. In this approach, the first step is to identify the objects that you want to model. Then you create classes from which those objects are 'manufactured'. Data templates are associated with these classes. For example, you may define that the class 'catchment' has the data attributes inflow, outflow, area, %slope, etc. Then you write a model for that class which uses those data attributes.

However, most participants tackle the 'problem' the other way around - ie consider the model first, in so doing the data attributes are created, and then (maybe) think about the objects. How best to resolve this is under investigation.

ICMS is scheduled for release in mid 2001.

References

Croke, B. F. W., Newham, L. T. H., and Jakeman, A. J. (2000). Integrated Catchment Management System: Water Quality Module. Hydro 2000 3rd International Hydrology and Water Resources Symposium, Perth, Western Australia. The Institution of Engineers, Australia. Volume 2, pp 779-784.

Gilmour, J. K., Croke, B. F., and Watson, W. D. (2000). An Integrated Modelling Approach for Assessing Water Allocation Rules. Hydro 2000 3rd International Hydrology and Water Resources Symposium, Perth, Western Australia. The Institution of Engineers, Australia. Volume 2, pp 947-952.

Newham, L. T. H., Croke, B. F. W., and Jakeman, A. J. (2000). Water Quantity Modelling within the Integrated Catchment Management System (ICMS). Hydro 2000 3rd International Hydrology and Water Resources Symposium, Perth, Western Australia. The Institution of Engineers, Australia. Volume 2, pp 1069-1074.

Letcher, R. A., Cuddy, S. M., and Reed, M. (2000). An Integrated Catchment Management System: A Socioeconomic Approach to Water Allocation in the Namoi. Hydro 2000 3rd International Hydrology and Water Resources Symposium Perth, Western Australia. The Institution of Engineers, Australia. Volume 2, pp 953-958.

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ADVANCE WARNING OF UPCOMING TRAINING WORKSHOP

CONTINUOUS SIMULATION OF LOSSES FOR DESIGN FLOOD ESTIMATION

by Dr Walter Boughton

27 March 2001, Brisbane

Registrations are limited to 20 participants. Acceptance of registration will be strictly on a first-in basis.

Expected workshop cost is $150 including copies of programs and manual, use of the training facilities, lunch and morning and afternoon teas.

Registrations will be taken early in the new year. For any preliminary enquiries please contact:

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More details are available at www.catchment.crc.org.au/news

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

27-29 August 2001

Hilton Hotel
Elizabeth Street
Brisbane

The Third Australian Stream Management Conference will be held during 27 - 29 August 2001 in conjunction with the 2001 RiverSymposium (29-31 August) and associated with the Third Australian Fishways Technical Workshop (30-31 August).

In support of the 'Value of Healthy Streams' theme, the Conference is centred on four key areas:

· Ecosystem services
· Hydrological connectivity
· Bio-physical integration
· Tools and techniques

PLANNING TO ATTEND, SUBMIT A PAPER OR A POSTER?

To register your interest in attending the conference or submitting an abstract, please send an email with all your contact details to stream.conference@dnr.qld.gov.au

The deadline for abstracts is close of business Monday 29 January 2001.

More details are available at www.catchment.crc.org.au/news

PROGRAM 2
LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Christy Fellows

Denitrification in riparian zones of the Brisbane River catchment

The primary focus of Project 2.5: "Nitrogen and Carbon Dynamics in Riparian Buffer Zones" is to determine how riparian zones in the Brisbane River catchment function to reduce nitrogen loading to streams. There are multiple pathways to retain and transform nitrogen within riparian zones, but denitrification (conversion of nitrate to nitrogen gas) is of particular interest because it effectively results in a permanent removal of nitrogen from the system.

This article provides an overview of the major factors that influence denitrification and what we expect to find in riparian zones of the Brisbane River catchment.

Controls on rates of denitrification

Denitrification is the reduction of nitrate to a nitrogen-containing gas, typically dinitrogen (N_2) or nitrous oxide (N_2O). This process is carried out predominately by certain groups of microbes that use nitrate instead of oxygen during respiration. An environment with no oxygen is needed for denitrification because most microbes capable of denitrification will use oxygen, if it is available, in preference to nitrate. Typical environments where denitrification occurs are saturated soils and sediments where diffusion of oxygen is limited and/or oxygen is consumed by respiration. In environments which are generally oxygen-supplied such as well-drained soils, denitrification can also occur at sites or in pockets lacking oxygen.

Nitrate can be supplied naturally through the breakdown of organic matter and subsequent nitrification of ammonium, but very high concentrations most often result from human inputs, including fertilisers and sewage. Finally, the quantity and quality of organic carbon available to denitrifying microbes often controls the rate of denitrification. Sources of organic carbon include organic matter deposited with sediment, material exuded from roots, decomposing fine roots, and dissolved organic compounds.

Denitrification in riparian zones

Riparian zones have great potential for supporting denitrification because:

- riparian vegetation can provide organic carbon to support microbial respiration, and
- riparian zones are often in locations with shallow watertables and saturated, oxygen-deficient soils and sediments.

Previous work in Europe, North America, and New Zealand has shown that riparian buffer zones can remove upwards of 90% of nitrate in subsurface flows. These high nitrate removal rates been found typically in places with permeable surface soils and sediment underlain by a relatively impermeable layer – a layer which forces groundwater to remain shallow and flow through organic rich soils. In contrast, if groundwater flows more deeply, bypassing the organic carbon-rich rooting zone and discharging directly into the stream channel, the riparian buffer will have little effect on nitrate concentration. These findings highlight the importance of site hydrology in bringing together the factors which maximise denitrification and provide the opportunity for plant uptake.

What do we expect to find in the Brisbane River catchment?

Hydrology is one of the most important controls on denitrification. Both climate and seasonal hydrology in the Brisbane area are very different from the sites which have been studied in North America and Europe. How do these differences influence the functioning of riparian zones in the Brisbane River catchment?

In most of the North American and European studies, the groundwater table sloped toward the stream, and groundwater flowed at shallow depths through the riparian zone into the stream.

In more arid regions like Brisbane, groundwater flow may be different.

For riparian buffers to be effective, nitrate rich water must move through riparian zones before entering streams. If overland flow is the dominant pathway of water to the stream, the opportunity for denitrification in the riparian zone is limited. Similarly, if a stream reach is losing water to the groundwater, and the groundwater table slopes away from the stream, the riparian zone is not in a direct position to improve surface water quality. In all situations where the groundwater table is much deeper than the rooting zone, the effects of a riparian buffer will be limited. Characterising hydrology at chosen study sites and small streams throughout the Brisbane River catchment is an important component of Project 2.5.

Study design

In collaboration with the CRC for Coastal Zone, Estuary, and Waterway Management, we will install networks of wells and piezometers at two sites, a lowland riparian wetland and an upland riparian zone. We are aiming to choose sites that have high potential rates of

denitrification, relatively shallow groundwater, and well developed riparian vegetation. After describing groundwater flow at the sites, we will measure in situ rates of nitrate retention along subsurface flow paths using tracer techniques.

Additionally, we will combine these field studies with laboratory experiments to determine those factors which limit the rates of denitrification at the sites. Future plans include developing criteria to generalise findings from these two sites to larger areas within Brisbane River catchment using hydrologic modelling.

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PROGRAM 3
SUSTAINABLE WATER ALLOCATION

Program Leader
JOHN TISDELL

Report by John Tisdell

Attitudes to COAG reform in the Goulburn Broken Catchment

The Council of Australian Governments (COAG) introduced various institutional changes to water management in Australia. The first section of the survey conducted in the Goulburn Broken catchment in Project 3.2 dealt with COAG reforms, specifically, with issues of water pricing, the definition of water rights, and the notion of trading such rights. This article reports findings of the survey.

Agreement with Water Reform

Effective adoption of these changes requires acceptance by water users and the community at large. Table 1 reports irrigator and community responses to the question of the need for water reform. Some 79% of irrigators and 88% of community respondents agree that water reform is necessary.

Table 1. Overall agreement with the need for water reform

	IRRIGATORS		COMMUNITY	
	Frequency	Percent	Frequency	Percent
Yes	196	79.0	173	88.3
No	52	21.0	23	11.7
Total	248	100.0	196	100.0

Water Pricing

As part of the reform process, water authorities need to move towards cost recovery and in the process introduce full cost pricing. Table 2 presents the irrigator and community views on full cost pricing of water. More than 48% of irrigators within the catchment said they rejected the notion of full cost pricing. The community is more supportive with over 49% strongly supporting or accepting the notion of full cost pricing and some 34% rejecting or completely rejecting such a pricing policy.

Table 2. Full cost pricing of water

	IRRIGATORS		COMMUNITY	
	Frequency	Percent	Frequency	Percent
Strongly support	16	6.6	36	18.9
Accept	71	29.1	58	30.5
Indifferent	38	15.6	31	16.3
Reject	82	33.6	45	23.7
Completely reject	37	15.2	20	10.5
Total	244	100.0	190	100.0

NEW CRC VIDEO

IRRIGATORS' ATTITUDES TO WATER ALLOCATION AND TRADING IN THE GOULBURN-MURRAY CATCHMENT

Dr John Tisdell
Program Leader - Water Allocation
CRC for Catchment Hydrology
Griffith University

November 2000

CRC Video 00/6

This presentation describes the results and findings of a survey of irrigators' attitudes to COAG reforms: temporary and permanent water trading; the role of the water authority in the market; and the environmental impact of trade. The survey also elicited irrigators' attitudes to breaking the nexus between land and water, points of blockage in current water markets and possible adjustments to trading rules and procedures.

COPIES ARE AVAILABLE FOR $27.50 (INC GST, POSTAGE AND HANDLING) THROUGH THE CENTRE OFFICE.

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

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Find it easily at www.catchment.crc.org.au/contact

Definition of rights and the nexus between land and water

A main element of COAG reform involves the definition and specification of water entitlements and the rights attached to those entitlements.

The primary step in establishing a functional water market is to break the long-standing nexus between land and water rights. A principal aim of the reform process is to change the nature of water rights from one inextricably tied to the land to more of an independent and distinct chattel.

The results of the survey suggest that there is overall agreement that the nexus between land and water should be broken and water rights be traded as chattels separate to land. This view is stronger among irrigators than the wider community, and among irrigators who have traded compared to those who have not.

Issues in the definition of the water right itself include the rights to on-farm runoff, the status of water for the environment, and the rights to sleeper and dozer licences. Overall, the notion of licensing on-farm runoff is rejected by irrigators and the general community. Setting aside water for the environment prior to allocating it to farmers is supported overall, but less by irrigators than the community at large. The irrigators expressed indifference to setting aside water for the environment prior to allocating it for their use. Finally, while there is overall indifference towards the notion of extinguishing sleeper and dozer licences, the community and irrigators attitudes are divided - irrigators strongly reject the notion, while the community supports extinguishment.

Security and certainty of supply

Along with the definition of rights are issues of security and certainty of supply. The survey results suggest that there is general agreement among irrigators in the Goulburn Broken catchment that water entitlements will be more secure and have higher reliability following the reform process. Traders and non-traders of water alike hold this view.

Conclusions

Overall, the results of the survey in the Goulburn Broken catchment concerning COAG reforms suggest there is strong support for water reform, and in particular breaking the nexus between land and water.

Irrigators in the catchment believe that their water entitlement will be more secure and have higher reliability following the reform process.

There is overall support for setting aside water for environmental use, but uncertainty concerning the status of sleeper licenses.

The catchment is divided over the issue of full-cost pricing with irrigators rejecting the notion, but accepted by the catchment community at large.

Finally, the notion of licensing on-farm runoff is rejected by irrigators and the community at large.

The results of this component of the survey will assist is developing strategies to promote adoption of water reform in the Goulburn Broken catchment.

It is proposed to publish a CRC for Catchment Hydrology report on the survey with detailed analyses of the responses.

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PROGRAM 4
URBAN STORMWATER QUALITY

Program Leader
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Report by Peter Breen and Tony Wong

Suspended Solids Removal in Stormwater Wetlands: Quantifying the Role of Aquatic Macrophytes

Wetlands or Ponds?

Urban stormwater management systems frequently have multiple objectives - water quality improvement and landscape aesthetic values are two common objectives. Ponds and wetlands are commonly adopted in stormwater treatment in two distinct phases, ie. particle removal during event flow and pollutants processing during the inter-event period. The distinction between wetland and ponds is vague, but can be based on the degree of vegetation cover.

Ponds have fringing vegatation with less than 30% vegetation cover while wetlands have uniform vegetation bands with over 50% vegetation cover. There is often some conflict between the extent of open water and vegetated cover in urban constructed wetlands with ponds often the preferred choice for landscape amenity in land development. To help provide a rational basis for the choice between wetlands and ponds, and the degree of vegetation cover required for the desired water quality treatment, it is necessary to quantify the role of macrophytes in the removal of suspended particles during storm events.

Role of Wetland Plants

In her MEngSc study (1995-1997), CRC postgraduate Sara Lloyd examined wetland plant surfaces using light- and electron-microscopy, including staining techniques to distinguish between mineral, algal and bacterial particles. Results demonstrated the enhanced sedimentation and particle adhesion functions of plants. Examination of Schoenoplectus validus, a common species of wetland vegetation, for example, showed particles as small as 0.5-2.5 mm sticking to both the plant surface and the epiphytes.

Earlier this year, field investigations were undertaken to quantify the contribution of wetland macrophytes in promoting the removal of particulates. Field experiments compared particle removal in a vegetated system and an open water system using two experimental sediment treatments (fine and coarse) under two hydraulic loadings.

Field site

The field site was the Hallam Valley stormwater treatment wetland, in Melbourne. The field preparation involved the establishment of two experimental channels of approximately 3 m wide, 20 m length and 250 mm deep (*Figure 4*). One channel was densely vegetated with *Eleocharis acuta* (Slender spikerush) and the other, which serves as a control channel, is open water with all vegetation removed.

Methodology on site

Steady flow conditions were first established before inputs of sediments of known particle size distribution (PSD) were carried out. The PSD of the sediment treatments ranged from 250 mm to <1 mm. Two sediment treatments were applied with PSD characteristics, described as clay dominant (Fine Mix with 50% particles < 20 mm) and sand dominant (Coarse Mix with 25% particles < 20 mm). Sodium Bromide was used as the conservative tracer in the experiments. Water was sampled at six locations along the twenty metres length of the channels to track the change in concentrations of suspended solids, the particle size distribution and water turbidity as flow passes from the inlet to the outlet of the experimental channels (*Figure 5*).

Figure 4 Two channels established for the field experiments at the Hallam Wetland.

Figure 5 Sampling water in the vegetated channel

Conclusions to date

The results of the experiments led to the following conclusions:-

- flow conditions in the open water "control" channel did not always exhibit uniform flow conditions with wind-induced turbulence being a dominant factor disrupting uniform flow conditions; flow conditions in the vegetated system did approximate uniform flow conditions.
- no significant change in the PSD occurred between the first and last sampling point with the PSD ranging from 0.4 um (5%tile) to 15 um (95%tile); while the PSD

TECHNICAL REPORT

A MODEL FOR DISAGGREGATING DAILY TO HOURLY RAINFALLS FOR DESIGN FLOOD ESTIMATION

by

Walter Boughton

Report 00/15

This report addresses the task of producing 'appropriate' patterns of hourly rainfalls for the generated daily values, a process termed disaggregation.

Copies are available for $27.50 (inc. GST) from the Centre Office

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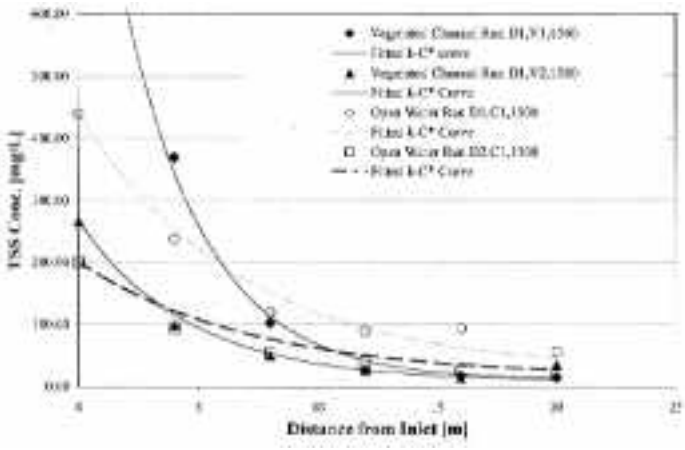

Figure 6 Typical Fitting of k-C model to TSS concentrations along experimental channels*

remained unchanged, both suspended solids and turbidity decreased with distance from the inlet. This suggested that sedimentation theory does not appear to be appropriate for predicting the removal of small particles of less than 15 um in turbulent systems.

- the observed reduction in SS concentrations with distance from the inlet can be described by a first order kinetic model, referred to as the k-C* model, ie.

$$\frac{dC}{dx} = -\frac{k}{q}(C - C^*)$$

[where q is the hydraulic loading rate; C is the concentration of the water quality parameter; C* is the background concentration or the irreducible concentration of the water quality parameter and k is the areal rate constant].

Some typical calibration results are shown in *Figure 6* and they indicate the suitability of a first-order model in describing the rate of SS removal as flow passes through the channels.

- The presence of vegetation resulted in a significantly higher rate of suspended solids removal and minimised particle resuspension by wind and flow velocity effects. This is reflected in consistently lower calibrated C* values and higher k values for the vegetated runs.

- The higher C* value for the open water system is attributed to a combination of resuspension of deposited material and maintenance of inflow fine solids in suspension by wind-induced turbulence. In the vegetated channel, the macrophytes were observed to have effectively shielded the deposited material from the effect of wind.

- The higher k value calibrated for the vegetated channel reflects a higher rate of suspended solids removal in the vegetated system compared with the open water system. The k values for vegetated systems are generally twice that for the open water control systems as shown in *Figure 7.*

Justification for 'vegetation factor'

These preliminary results suggest there is some justification for the introduction of a "vegetation factor" into wetland particle removal calculations. The factor could be introduced in several ways. If first order modeling approaches are adopted, k values could possibly be increased by up to a factor of two. If sedimentation theory was used settling rates could possibly be increased by up to a factor of 2.

Given the preliminary nature of these experiments we would suggest that adjustments greater than two should not be used in practice.

This article is a summary of a paper of the same title by Tony H F Wong, Peter F Breen, Sara Lloyd, Tracey Walker, Britta Dahnke & Richard Wootton, and presented by Dr Peter Breen at the 7th International Conference on Constructed Wetlands in Pollution Control, 12-17 November 2000, Orlando, Florida, USA.

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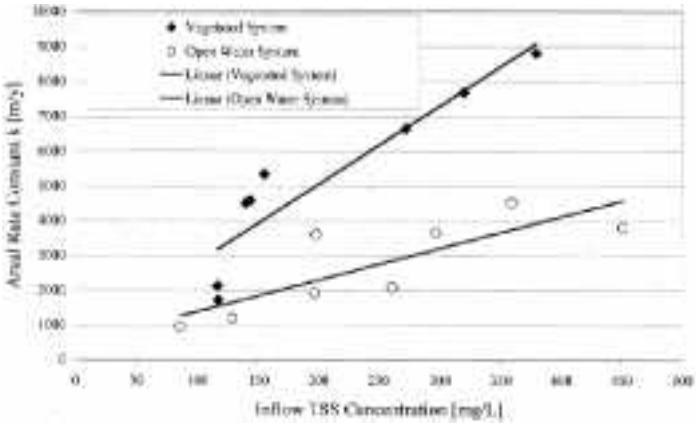

Figure 7 Variation in fitted areal constants with inflow TSS concentrations

PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM McMAHON

Report by Alan Seed and Tom Keenan

Forecasting rainfall for the Olympic Games

Introduction

The Sydney 2000 Olympic Games was the sort of major international event where severe weather could have had a major impact on outdoor activities. The Bureau of Meteorology (BOM) was responsible for providing an operational service that issued forecasts at 1-3 hourly intervals for temperature, humidity, wind and rain for each of the nine prime Olympic venues. During storms and severe weather, 'nowcasts' (up to 2-hour forecasts) were issued at 15-minute intervals for each Olympic venue. The Bureau deployed three weather radars, another able to measure the wind profile through the atmosphere, a network of automatic weather stations in strategic locations, and increased the frequency of upper air soundings as part of their commitment to provide a world class service to the Games.

Forecasting demonstration

The World Weather Research Program (WWRP) is a program of the World Meteorological Organisation (WMO) to develop improved forecasts of the sort of weather which affects quality of life, is disruptive, or is life threatening. A component of the WWRP is to demonstrate the capability of modern forecast systems and to quantify the associated benefits in the delivery of a real-time nowcasting service. The WWRP took advantage of the enhanced observation network in Sydney over the Olympic Games to demonstrate how state-of-the-art nowcasting systems can be used in an operational setting. The project ran from 1 September to 30 November 2000. While the products generated by these systems were used to provide nowcasts for the Olympic Games, the weather elements being forecast are also of considerable interest for a wide range of applications including aviation and flash flood warnings. An International WMO workshop was held at the end of the observation period to allow interested paries to observe the operational systems.

Fortunately, the weather during the Games was generally benign, although the stress experienced by those involved in forecasting the weather for the opening and closing ceremonies should not be under-estimated. The most severe weather during the WWRP period was experienced during the WMO workshop when severe winds associated with a hailstorm caused significant damage to houses in western Sydney.

Real-time / nowcasting systems

Six nowcast systems were used in an operational framework to provide real-time forecasts to users:

- United States Warning Decision Support System from the National Severe Storms Laboratory
- United States National Center for Atmospheric Research Autonowcaster
- NIMROD from the United Kingdom Meteorological Office (UKMO)
- Generating Advanced Nowcasts for Deployment in Operational Land-surface Forecasts system from the University of Salford and the UKMO in the UK
- Canadian Radar Decision Support System
- Australian Spectral PROGnosis (S_PROG) system [described in a previous *Catchword* article].

These systems employ observational techniques, numerical weather prediction, and a combination of both. The nowcasts were generated automatically and were made available to the Bureau forecasters responsible for issuing Olympic, specialist user, and other forecasts through a web-based interface.

CRC and BOM collaboration (the S_PROG model)

BOM as a Party to the CRC for Catchment Hydrology has been actively researching the use of weather radar data in hydrological applications since 1997. This work has seen the development of a stochastic space and time model of rainfall (Motivate) (Seed el al., 1999); current work includes a project on modelling and forecasting the space and time characteristics of rainfall. Motivate has been further developed into the S_PROG model for nowcasting as part of this project, and the working prototype was installed in Sydney as a contribution to the WWRP project described above. S_PROG is also being evaluated in New Zealand by the National Institute of Water and Atmosphere (NIWA) as the nowcasting component of a flash flood warning system currently being developed by NIWA.

Evaluation of alternative systems

Each system has a different set of forecast elements (rainfall, wind field, and identification of severe weather including hail, tornadoes, gust fronts, and downbursts) over a range of forecast periods. The diversity of products and display systems makes it difficult to rank the systems relative to each other overall, since each system will be applicable in some situations and applications and not in others. Therefore, the aim of the project was not a competition to find the best nowcast system, but rather a demonstration of the utility of such systems in a range of situations and applications.

An independent international verification and impact study team will compare and benchmark the WWRP nowcasts and assess them for added value and impact relative to current (official) BOM products. This is a major task, which is expected to take some time as the project generated 2 giga bytes of archive data per day over the 100-day project.

Reference

Seed, A.W., R. Srikanthan, and M. Menabde, 1999, A space and time model for design storm rainfall. J. Geophys. Res., vol. 104 (D24) 31623-31630.

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NEW CRC TECHNICAL REPORT

STOCHASTIC GENERATION OF CLIMATE DATA: A REVIEW

by

Ratnasingham Srikanthan
Tom McMahon

Report 00/16

This report reviews the state of research and practice in the stochastic generation of annual, monthly and daily climate data.

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

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

27-29 August 2001

Hilton Hotel
Elizabeth Street
Brisbane

The Third Australian Stream Management Conference will be held during 27 - 29 August 2001 in conjunction with the 2001 RiverSymposium (29-31 August) and associated with the Third Australian Fishways Technical Workshop (30-31 August).

In support of the 'Value of Healthy Streams' theme, the Conference is centred on four key areas:

- Ecosystem services
- Hydrological connectivity
- Bio-physical integration
- Tools and techniques

PLANNING TO ATTEND, SUBMIT A PAPER OR A POSTER?

To register your interest in attending the conference or submitting an abstract, please send an email with all your contact details to stream.conference@dnr.qld.gov.au

The deadline for abstracts is close of business Monday 29 January 2001.

More details are available at www.catchment.crc.org.au/news

PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Rebecca Bartley

Quantifying recovery in disturbed streams

Background

Those of you that are avid *Catchword* readers will recall my previous articles describing sediment slugs (including their bums!), and the details of my preliminary research (*Catchword* Feb 1999, May 2000). The main focus of my PhD is to look at the geomorphic recovery processes in disturbed streams, using sediment slugged streams as a case study. After sifting through mounds of data, I am starting to get some interesting results...I will skip over most of the detail relating to data collection, briefly mention methodology, and get to the juicy stuff - results.

Describing the recovery process

To describe the recovery process, I needed to devise a number of methods for characterising the level of physical disturbance within a particular reach. This required quantifying the physical structure (geomorphology) of the channel. Then, by measuring the channel in stream sections that were identified as control reaches (no sand), impacted reaches (lots of sand), and recovering reaches (where sand has left the system), the level of disturbance, and hence recovery, can be evaluated. The three streams used for this study were Creightons Creek (central Victoria), the Wannon River (western Victoria) and the Ringarooma (north east Tasmania).

Thalweg- a useful variable

I will discuss the results of only one of the geomorphic variables measured in this study: the thalweg. The thalweg is the deepest thread of water along a channel and is described by measuring the distance and height or elevation of the longitudinal bed profile of a reach. The thalweg provides a lot of information about the physical structure of the river, including the presence of pools and riffles, which are seen as key habitat features in many streams. Defining the thalweg is also a relatively rapid assessment technique that can be measured independently of discharge.

Analysing thalweg data

The thalweg data were then analysed in two different stages. The first stage was to quantify the variability of the thalweg profile. This was done using techniques such as fractal analysis, local linear smoothing (Loess), regression analysis and various methods for quantifying the 'wiggliness' or change in vector dimensions of the thalweg profile. This step essentially described the current variability of the stream and represented 'observed' data. The second stage in the analysis was to determine the level of variability that would occur within in each reach under natural conditions. This is an important step, as it not always possible to compare reaches from different parts of a stream, as they would be different even without disturbance. This method involved scaling known morphometric properties of thalweg profiles with catchment area. This step estimated the 'expected' or pre-disturbance level of variability for each reach.

'Expected' versus 'observed' data

The difference between the expected and observed values were then subject to statistical analysis (one-way between groups ANOVA). This provides a rigorous, objective method for quantifying the recovery of a stream. The reaches are considered to be recovered when there is no significant difference between the observed and expected values for the recovered reaches. For simplicity, the results are presented using just one of the measures applied to analyse the variability of the thalweg. The results in *Figure 8* use the standard error of the thalweg data about a regression line to describe the 'thalweg variability'.

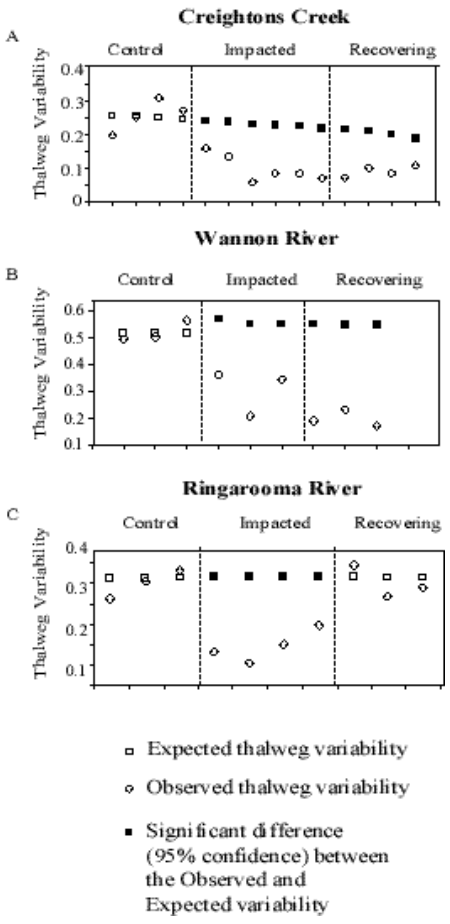

Figure 8: Difference between the observed and expected values of thalweg variability.

Some preliminary findings

In this study, both Creightons Creek (*Figure 8A*) and the Wannon River (*Figure 8B*) have significantly different observed and expected values in their recovering reaches (at the 95% confidence level), with the Wannon River appearing to be the least recovered. However, the Ringarooma River (*Figure 8C*) appears to have recovered its thalweg variability, as it shows no significant difference once the sediment has moved out of the stream. Despite the variable recovery periods on each stream, the geomorphic characteristics of the Ringarooma River appear to be more conducive to re-establishing its pre-disturbance condition.

Implications for stream restoration

These preliminary findings have some interesting implications for the restoration of disturbed streams, in particular, the allocation of stream restoration funding. Understanding recovery processes and then identifying which streams will recover independently of human intervention has the potential to save money, and allow existing funds to be spent more appropriately.

If anyone has any useful comments or is interested in the details of this research, please don't hesitate to contact me.

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COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

The Flow on Effect – December 2000

Program news and great Christmas gift ideas from the CRC!

In the final *Catchword* article for this millennium, I would like to briefly list some recent activities in the Communication and Adoption Program and list some innovative Christmas gift ideas from the CRC!

Salinity Disposal Basin Reports available on-line

The CRC Project S2, 'On-Farm and Community Scale Salt Disposal Basins on the Riverine Plain', is a collaborative project between the CRC for Catchment Hydrology, CSIRO Land and Water and the Murray-Darling Basin Commission. The project, led by Glen Walker and Kumar Narayan (CSIRO Land and Water), formed part of the initial CRC's Salinity Program (1997-1999).

The outputs of the project include a series of fifteen high quality reports covering key issues in the use of salinity disposal basins. Most of these reports are now available for downloading as pdf files from the CRC website at the address; www.catchment.crc.org.au/disposalbasins

Each report is also available as a printed document for $27.50 (inc. GST) from the CRC Centre Office. Contact Virginia Verrelli on 03 9905 2704 for further details.

Staff database on-line

The CRC staff directory (containing staff contact details) is now available on our CRC website (www.catchment.crc.org.au/contact). The directory includes staff telephone, fax, email and postal addresses. The search feature allows you to search contact details by first or second name, organisation and state. If, for example, you heard Rob from the CRC in Canberra present at a seminar recently, then you'll be able to track down his contact details using the search engine. All courtesy of our CRC webmaster, Daniel Figucio at CSIRO Land and Water.

Annual Report also on-line

If you would like to obtain a copy of our 1999-2000 Annual Report, it is also available as an Acrobat pdf file for downloading from our website. Just follow the links on the home page.

Project sheets – printed copies now available

Printed versions of the CRC project sheets (two page documents describing the key elements of research projects in CRC Programs except River Restoration and Communication and Adoption) are now available from the Centre Office. There are thirteen project sheets in total, and each gives details of research objectives, expected outcomes, target problems, key tasks, links, staff involved and contacts for that CRC project. They are an excellent way to quickly familiarise yourself with the nature and extent of our research program.

CRC PROJECT SHEETS

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Copies are available by contacting Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au.

These sheets are also available for downloading from our website.

Look under Research 1999-2006 and follow the links for 'detailed information'

WHAT'S HAPPENING WHEN?

FIND OUT ABOUT CRC EVENTS BY EMAIL

THE CRC WILL NOTIFY YOU BY EMAIL OF AN UPCOMING CRC EVENT IN YOUR AREA OF INTEREST.

You can register to receive this information through our website - click on '*Catchword*' and then 'subscribe'

or you can contact Virginia Verrelli at the Centre Office on 03 9905 2704.

Copies are available by contacting Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au. These sheets can also be downloaded from our website. Look under Research 1999-2006 and follow the links for 'detailed information'.

Project sheets for the River Restoration Program will be available early next year.

Special CRC Feature in 'Water'

The current (November 2000) and next edition (January 2001) of the Australian Water Association's (AWA) Journal 'Water' contains a special CRC feature covering some of the highlights of the CRC for Catchment Hydrology's past and current research. A number of articles, one from each CRC Program, focusing on the practical application of our research in the water management industry are presented. (The November edition may be hard to locate if you are not an AWA member or know somebody who is, but your library or organisation may subscribe to the Journal.)

The January 2001 edition will feature articles by lead authors: Jacki Croke (Managing Sediment Movement and Sources in Forests), Francis Chiew (Seasonal Streamflow Forecast and Water Resources Management), John Fein (Postgraduate Education in the CRC for Catchment Hydrology), John Langford (The View from the Chair), Ian Rutherfurd (Planning for Stream Rehabilitation: Some help in turning the tide) and John Tisdell (The Evolution of Water Management in Australia).

Two New Technical Reports for the Christmas Stocking

Two new technical reports have recently been published by the CRC and each is available from the Centre Office for $27.50 (includes GST, postage and handling):

• A Model for Disaggregating Daily to Hourly Rainfalls for Design Flood Estimation by Walter Boughton. CRC Report 00/15. Published in conjunction with the initial CRC's Flood Hydrology Program, this report addresses the task of producing 'appropriate' patterns of hourly rainfalls for the generated daily values, a process termed disaggregation.

• Stochastic Generation of Climate Data: A Review by Ratnasingham Srikanthan and Tom McMahon. CRC Report 00/16. This report reviews the state of research and practice in the stochastic generation of annual, monthly and daily climate data. The review forms part of the CRC's Climate Variability Research Program led by Tom McMahon at The University of Melbourne.

To order copies of these CRC reports, contact Virginia at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

That's about it for another year. Thanks to all those who contributed to the success of the Communication and Adoption Program in 2000. Happy Christmas and enjoy the break – see you next year!

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POSTGRADUATES AND THEIR PROJECTS

Our postgraduate for December is:

Brett Anderson

As a graduate of the RMIT Aerospace Engineering program the first question I feel bound to answer in this article is one that has challenged humankind since the dawn of time (or thereabouts): "Why am I here?"

From rocket science to rivers

You would think, and indeed it is often remarked, that to be a Rocket Scientist is the dream of every young boy. It is a profession immortalised in song, where you get to play with leading-edge technology and also comes free with a guaranteed pick-up line :

Girl: "So what do you do?"
Boy: "Well, I'm a Rocket Scientist …"

Whilst that opening is usually met with skepticism it always sparks conversation. But I digress.

With so much going for it why jump ship? Well the answer lies in my original question - "Why am I here?" With each of the four positions I held as an Aerospace Engineer I had one fundamental problem - no passion! Essentially I was not the slightest bit interested in the goals of the work, perhaps not surprising when they included building bigger, badder bombs.

Having met many of you at the CRC for Catchment Hydrology annual workshop earlier this year at Mount Buffalo, it is readily apparent that the world of catchment hydrology does not lack for energy, enthusiasm and drive. Hence, you can understand that it took Chris Gippel and Ian Rutherfurd very little to persuade me to take the PhD plunge and focus on rivers rather than rockets.

From hypersonics to hydraulics

The challenge I faced was to define a relevant and interesting project that would take advantage of my skills in aerodynamics and simulation modelling, whilst also allowing, no, requiring me to get out to camp and kayak along some rivers!

I started with a general notion of examining the connection between the channel condition (eg network morphology, large woody debris distribution, etc.) and the response function down the catchment (ie hydrographs). A fairly broad question and one which took me down many literature trails - perhaps most notably resulting in an early attempt to revolutionise current open-channel hydraulic

modelling practices by doing away with Manning's 'n'. I soon discovered this to be a tad ambitious and have since scaled down my PhD vision (although the concept is still simmering on the back-burner!)

I am now pursuing research into the influence of riparian management on flood hazard at a catchment scale. My work will contribute to CRC Project 2.1 and to the Land and Water Resources Research and Development Corporation (LWRRDC) Riparian Lands Research and Development Program. I am based at The University of Melbourne under the supervision of Dr Ian Rutherfurd and Dr Andrew Western. A synopsis of the purpose of the research and the anticipated outcomes follows.

Riparian management and flood hazard

Flooding is a product of catchment land-use, as well as the characteristics of the channel network that delivers floods downstream. Much of the damage to riparian vegetation and the de-snagging of Australian streams was completed to reduce channel roughness associated with minor flooding.

Now, as stream managers encourage the reintroduction of riparian vegetation and large woody debris (LWD) to streams, it would be foolish to do so without a clear idea of the flood implications of these changes. Changes to riparian vegetation affect the hydrological component of floods (ie the way in which precipitation enters channels), as well as their hydraulics (ie the way in which floods are conveyed down a channel because of changed roughness). Thus, this project has two purposes:

- To determine the hydrological impact of near-stream vegetation on the amount and timing of water entering the stream network (the hydrological effects of riparian vegetation)
- To determine the hydraulic effect of riparian vegetation and large woody debris on the magnitude and duration of floods of different recurrence (eg 50 year floods vs 5 year floods).

Both of these problems have to be considered at a catchment scale. For example, dense riparian vegetation in low-order streams could reduce water yield to the stream, and then attenuate the flood peak (due to roughness) producing a decrease in the flood peak further down the catchment. There is anecdotal evidence to suggest that this may be the case. For example, historical accounts suggest an increased frequency and severity of flooding along the Hunter River main channel following extensive clearing of riparian vegetation. However there are no definitive data on the relationship between riparian vegetation and flooding.

It is also important to consider the implications of changes in flood duration in different environments. For example, different types of floodplain crops could be more or less affected by floods of different duration. Urban areas may be particularly sensitive to even small changes in flood stage produced by riparian vegetation. Thus the project outcomes should be relevant to a range of catchment and land-use types, including urban.

The objectives of this work are to improve our understanding of the hydrological and hydraulic impacts of riparian vegetation on flooding. A modelling framework will be developed that can combine the hydrological and hydraulic effects of riparian vegetation with sufficient resolution to predict effects on floods down to a 5 year average recurrence interval (ARI). Additionally the model will allow predictions to made regarding the influence of riparian vegetation and large woody debris on flood stage and duration at various locations in the catchment for floods between 5 years ARI and 100 years ARI.

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WANT TO KNOW WHAT'S GOING ON?

The CRC event calendar at www.catchment.crc.org.au allows you a 'sneak preview' of what is coming up month by month.

Details of CRC events (workshops, seminars, field tours etc.) are posted on the site as soon as they become available.

LOOK UNDER 'EVENTS' ON OUR WEBSITE.

CRC PROGRAM SOFTWARE

Extreme Design Rainfalls for Victoria

The CRC FORGE-extract computer program has been produced to facilitate the extraction of rare to extreme rainfalls from the (at present, Victorian) database, and to present the information in forms needed for hydrologic design.

For further information see our website at www.catchment.crc.org.au/news

To obtain a copy of crcforge-extract contact Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

CRC PROFILE

Report by Graham Rooney

I've always been interested in natural history, and in boyhood had the notions of becoming firstly an ornithologist, and then later, a herpetologist. These ideas slowly disappeared with the realisation that there weren't many jobs around in these fields. Like other secondary students in the 1960s, I was 'streamed' into subjects that I had little choice over. Fortunately, I basically enjoyed the science subjects that I did study and duly received my matriculation certificate – now known as the VCE. Not ready to leave country Victoria, I then worked for five years in the textile industry, doing laboratory testing and fabric quality control.

After eventually moving to the 'big smoke' – Melbourne – I worked for a year in State Land Taxation. Enough money was earnt to supplement my TEAS allowance in a new phase as a full-time student (thanks Gough). Returning to my first love, I studied applied biology at RMIT, whereupon I discovered that studying biology was more like studying death – we killed so many animals during the course! I hope things have changed in current times.

After graduating in cell physiology and developing a deep interest in ecology, I worked around the traps in a range of jobs, waiting for something biological to emerge from newspaper columns. Driving taxis, cleaning new houses, brick-cleaning, and processing tobacco were followed by a stint as a temporary at the Commonwealth Serum Laboratories, where I never managed to bump into Struan Sutherland. At the end of the stint I sat the Public Service entrance exam, passed, joined the State Insurance Office, and ran across a country acquaintance who transferred me to the computer-processing department after an aptitude test. For those who may remember, the computer language of preference in that industry in those ancient times was COBOL. Even then, IT people were saying that the language would never last, but I believe there are still some compilers around today.

Computer programming was to be the 'second string to the bow' that enabled a successful appointment to the EPA of Victoria, in its Water Quality Branch. My career in the water industry had begun! This was 1980 and before the age of MicroSoft. DOS machines were not heard of, or their predecessor machine - CP/M – control program for microprocessors. I can't recall facsimile machines until some time later, but I remember being amazed at the technology. We never realised how much we would come to rely upon them in years to come. We used HP desktop computers and our own software to statistically analyse and graph water quality data.

I stayed with EPA for 13 years, working up to a middle-management position in its limnological team. They were rewarding times, especially seeing the acceptance of aquatic macroinvertebrates as a stream health monitoring tool. On the statistical side, the industry had historically used engineering-type statistics to describe water quality data. It was satisfying being part of a movement at EPA that attempted to redress that problem, by advocating medians over means, and non-parametric tests over parametric. There were many monitoring projects – on lakes, embayments, the coastline, estuaries, rivers and small creeks. For way too many summers I was associated with Port Phillip Bay beach monitoring – a perennial public issue and media nightmare. Apart from the technical environmental monitoring, life at EPA included participation in policy debates, court appearances as an expert witness, meetings with licensed dischargers, and oodles of correspondence and high-level briefings. One of my strengths came to be technical editing.

In 1993 I left EPA to join Melbourne Water Corporation. My role was to coordinate environmental research and studies, assist with preparation of submissions and briefings, and promote the use of modelling approaches to assist environmental management decisions. Re-structuring was happening all around me. In the first two years at Melbourne Water, I saw three different structural models. It was fascinating. Through the myriad of interactions and the need to still start and finish projects, I learnt more in those first few years than at any stage of my life – apart from one.

The perspective of one's place in the world was also so different at Melbourne Water. EPA had been the environmental be-all and end-all, but now that focus was put into a broader context of project management where environmental impacts were but just one part of the equation. Melbourne Water now numbers 480 staff and has been 'settled' for several years. I feel privileged to have worked with some great people. You learn rapidly from the great ones.

As CRC Focus Catchment Coordinator (FCC) for the Yarra River, I'll be developing a network of stakeholders and informing the network of CRC research. A key element of the new CRC is adoption of research findings. I have several portfolios in the Waterways group at Melbourne Water and one of them is technology adoption. A framework for adoption is being used by FCCs and in that network of stakeholders are the actual users of CRC research outputs. I will facilitate the identification of those users and attempt to smooth a passage towards adoption.

Graham works in the Waterways and Environment Division of the Waterways group of Melbourne Water, and is the Team Leader Research and Investigation.

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WHERE ARE THEY NOW?

Report by David McJannet

Since submitting my PhD thesis early in 2000 a number of changes have occurred in my life. My first position with the Australian Government was as an unemployed bum. I lasted only a couple of months in this position because I found the relentless paperwork, job seeker diaries, and employment seminars far too taxing. It was quite amusing being forced to apply for potential employment as a meat packer or supermarket manager after spending years developing the skills to be a forest hydrologist. Personally I still can't work out why my application for the lingerie salesperson was rejected.

Luckily for me (and the meat packers of Australia), I managed to secure a position with CSIRO Land and Water at the Tropical Forest Research Centre in Atherton Queensland. Upon arriving at the site I immediately doubled the number of Land and Water staff at the site, which now consists of Project Leader, Paul Reddell, and myself. Between us we have decided to solve the hydrologic problems of the entire area of tropical rainforest in far North Queensland "FNQ".

I remember leaving Monash Uni and our fearless leader, Russell, telling me that Atherton was a good place to go to get into some REAL hydrology. I now know what he means, the rainfall here is unbelievable, on a couple of the higher mountains annual rainfall has been known to exceed 10,000 mm. That's a lot of zeros after undertaking my PhD study during severe drought conditions in central Victoria.

Hydrological work in Australian tropical rainforest is, surprisingly, very limited. The project that I am involved with aims to measure the water balance of different rainforest types and to compare the water balance of these forests with that of adjacent alternative land uses. The forests we are planning to study cover a range of altitudes from sea level to higher that 1500m. The first of our field sites at 1000m has now been instrumented to measure stemflow, canopy interception, rainfall, transpiration, watertable fluctuations, and cloud interception.

The cloud interception part of our work should be very interesting because this is a component of the water balance which is usually ignored. Studies overseas have shown that in some forests, particularly high elevation cloud forest, cloud interception can add an additional 25 to 60% to rainfall. To measure cloud interception we are using a particularly raunchy piece of equipment known as a cloud stripper. This is basically a rain gauge fitted with a screen which traps cloud particles in a way similar to forest foliage.

The field measurements that I am undertaking will become an important component of a modelling exercise which is underway. The aim is to predict the likely hydrological effects that could arise from changes in land use.

Out of work hours there is no shortage of things to do with the surrounding world heritage areas, the great barrier reef, the amazing coast and stinking hot inland areas.

Much to the disgust of many of my 'Mexican' buddies, the warm weather up here has also contributed to the development of my taste for XXXX.

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LINKS TO KEY HYDROLOGY WEBSITES

We have recently updated our web links database. Our links pages feature a wide range of addresses and descriptions of key hydrological websites relevant to the land and water management industry.

If you want information about catchment hydrology, start with our website.

www.catchment.crc.org.au

If undelivered return to:

Department of Civil Engineering
PO Box 60
Monash University
Vic 3800

Surface Mail

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PP338685/00026

COOPERATIVE RESEARCH CENTRE FOR **CATCHMENT HYDROLOGY**

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, Qld
Department of Natural Resources and Environment, Vic
Goulburn-Murray Water
Griffith University
Melbourne Water
Monash University
Murray-Darling Basin Commission
Southern Rural Water
The University of Melbourne
Wimmera Mallee Water

Associates: • SA Water • State Forests of NSW •

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