NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 76 SEPTEMBER 1999

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

Inside...

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

A NOTE FROM THE DIRECTOR

Research into Practice: Making An Impact

I was honoured this year to be invited to give the Munro Oration at the Water 99 Joint Symposium (Brisbane 6-8 July 1999), and chose the above heading as the theme of my talk. Part of the inspiration for the topic was Crawford Munro's pioneering activities in the area; part was linked to my own career aspirations to do research that is 'useful'. Given that a good deal of what I said is relevant to the aspirations of CRCs; I'm using my column this month to give you some edited extracts.

About Crawford Munro

Crawford Munro was the Foundation Professor of Civil Engineering at the University of NSW, a position he held from 1953 to 1969. He, more than others, put hydrology "on the map" in Australia. This was achieved partly through his initiation of this Hydrology and Water Resource Symposium Series, partly through the important contributions of the large and talented research group he built at the University of NSW, and partly through his leading role in the first edition of Australian Rainfall and Runoff (3).

Some of my own career in hydrology overlapped with Crawford's period of influence: I had met him, and held him in high regard. However, I was reminded of him last year when a long-time colleague of mine (and of Crawford's), Eric Laurenson, had just retired. When Eric vacated his office at Monash, he left a huge pile of books and reports to whichever of his colleagues wanted them. However, he specifically 'bequeathed' to me three reports by Crawford Munro, two written before I had even started university!

The first two were volumes of the 1959 Launceston Flood Study. In this venture, set up by an act of the Tasmanian Parliament, Crawford was the Leader of a major project to reduce the flood hazard in Launceston. The work was, in the technical sense, state-of-the-art, including "the first use of hydraulic modelling for a flood study in Australia", "the first use of a computer for flood hydrograph estimation", and "the incorporation of benefit-cost analysis in the research scenarios" prepared for the study. For me, however, two other aspects were just as significant. Firstly, in the project arrangements, Crawford was committed to spending all of his out-of-semester time in Launceston (for two years), secondly, he made special efforts to address all of the concerns (complex and trivial) raised by the public in relation to the study. His report is a wonderful piece of writing, showing his gift for communicating complex issues in a simple way.

The third Munro report illustrated this last point more graphically. Crawford, in 1964, had just completed a major study of the Keepit Dam on the Namoi River, and written a technical report on the findings. The report left to me, however, was not the technical report, but one written for the "citizens of the Namoi Valley". Crawford had felt it important to write up the Namoi study for the community stakeholders, using language they could understand. Remember this was 35 years ago, well before most researchers even talked to the public at all about their work.

Relevance for the CRC

There are many parallels with Crawford's modus operandi and the aspirations we hold for the CRC for Catchment Hydrology. He was a great promoter of the application of state of the art science/engineering to real problems, and of industry/university secondments (both ways) to foster the links. He was a wonderful communicator, and used his skills to involve the community in the research issues being addressed. He put particular emphasis on further education and training; the research and coursework graduates from his school have been a lasting legacy of his influence.

The issues that face us now are more complicated and diverse than they were in Munro's time. Nevertheless, his strategy of good science/engineering, communication with stakeholders, close links with industry, and education and training is one which will lead us, like Munro, to 'make an impact'.

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Please note...

CRC publications and videos are listed in a separate document "CRC Publications"

Additional copies of the July to September Publications List are available from the Centre Office.

COPIES OF VIDEOS, REPORTS AND WORKING DOCUMENTS ARE AVAILABLE FROM THE CENTRE OFFICE AT $20 PER COPY UNLESS OTHERWISE NOTED AND CAN BE ORDERED BY CONTACTING:

VIRGINIA VERRELLI ON TEL (03) 9905 2704 or FAX (03) 9905 5033 EMAIL virginia.verrelli@eng.monash.edu.au

PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader

ROB VERTESSY

Report by Rodger Grayson

Background

As you are no doubt aware, the CRC Board is reviewing project proposals developed through the extensive TAG process. There is an ongoing effort to restructure the range of possible projects and develop a staged approach based on the priorities of participants and to fit in with resources available. In Rob Vertessy's absence, I have been asked to provide some information on the general areas where Program 1 "Predicting Catchment Behaviour" is intending to concentrate efforts over the next few years.

Program aims

This Program is directed towards modelling efforts to enable the prediction of catchment response across a range of scales. With the CRC for Catchment Hydrology expanding its interest into large catchments and long term response to changing land use and climate, this represents a major challenge. The Program combines projects aimed at improving the use and utility of existing models, as well as developing new approaches to model structure and data aspects. These approaches will be needed to address the expanded interests of the new CRC. Program 1 will be closely involved with other Programs since some of the specific modelling challenges faced by other Programs will be used as "case studies" to develop more generic approaches.

Integration framework

A key activity of Program 1 is likely to be the provision of a framework for the integration of a variety of existing models and newly developed ones (by Catchment Hydrology and others) into a toolkit for predicting catchment behaviour in a holistic fashion. Our plan is to pool a spectrum of modelling approaches (ranging from DSS and lumped-conceptual approaches at the 'simple' end, and distributed process-based models at the 'complex' end). We will adapt these approaches where necessary and develop links which will make it possible to exchange model output across the spectrum. By incorporating existing models as part of the testing and development procedure we aim to add value to modelling approaches already in use by CRC Parties, at the same time as engendering familiarity amongst a user base with a framework that will ultimately include a variety of modelling tools. The toolkit will provide a common 'look and feel' and delivery approach for CRC for Catchment Hydrology software, factors which should enhance adoption.

Transfer from small to large scale

At a more fundamental level, we hope to address the general difficulty in transferring our understanding and models of small scale processes to large scale modelling – an issue we see as a primary restriction to the development of advanced large-scale models. We have a lot of knowledge about how small catchments behave, based on field studies and detailed models. But these models cannot be applied to large areas because it is not possible to explicitly represent all of the small scale variability in things like soil moisture, soil hydraulic properties, vegetation, topography etc. that influence the catchment response. We are proposing to approach this problem by developing methods to represent the effect of small scale variability at larger scales, without having to represent the variability itself. Initially we plan to focus on soil moisture and soil hydraulic properties because of their importance to hydrological response, but the methodology will be equally applicable to other issues such as sediment transport.

Determining modelling uncertainties

Ultimately we also need to address how best to comprehensively determine the uncertainty of our predictions. Uncertainties in modelling hydrological systems result from the use of simplified models to represent what are usually complex systems, the use of incomplete data to calibrate the models due to limited record lengths, the limited number of variables observed, missing data, and measurement error. Methods need to be developed that enable these sources of error to be quantified and their influence on predicted behaviour determined. This topic will be critical to establishing realistic expectations about our ability to predict response and will be important to modelling right across the CRC as the models developed in the early stages are applied. At this stage it looks like work in this area will not be part of the first crop of projects, but is intended to be developed down the track.

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PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader

PETER HAIRSINE

Report by Jon Olley and Ian Prosser

Fluxes and stores in river systems

River processes

Rivers are not conveyer belts. What goes in at the top is not what comes out at the bottom. A large number of physical, chemical and biological processes occur which deposit, fractionate and alter the materials during transport. How much the material is altered is a product of the residence time of the material in the river system. The longer the residence-time the more significant the degree of change. Consequently, these processes are more significant in larger rivers systems. Understanding these processes is necessary if we are to better manage these systems.

Sediments and responses from large and small river systems

Unfortunately, most research into how sediments are generated and what happens to them in the river system has been done in small catchments. These systems respond rapidly, so changes in them are amenable to being studied by monitoring. This rapid response is due to high catchment gradients and high kinetic energy – properties not present in the lower reaches of large river systems. Small catchments are not scaled-down models of large systems. The time over which the lower reaches respond to change is much longer than in small, headwater catchments, and much longer than most instrumented time-series records. In many cases these changes may not be fully realised for decades or even centuries.

Modelling large rivers

In cases where research has been carried out on large rivers it has tended to focus on particular features, such as its hydrology, or on understanding particular reaches. A conceptual framework to bring all of this work together to produce a more holistic understanding of large river systems has been lacking. Although modelling a large river is a means of integrating information on its physical, chemical and biological processes, much of the work to date has focused on lower-order processes. The hope that reducing a system to its component parts and fundamental processes will yield understanding of the whole system has not been realised. Models, both conceptual and numerical, of large river systems that encapsulate the hydrology, ecology, and material fluxes are either not available, or are too complicated or abstract to be useful. This is a major gap. There is a clear need for a strategic, systems approach to understanding large catchments; an approach that applies across a range of spatial and temporal scales.

Proposed project

This is where the proposed project on : "Material transport and transformations" within Program 2: "Land use impacts on rivers" comes in. In conjunction with other initiatives focused on large system behavior, this project should aim to understand the sediment and nutrient sources, the processes by which the material moves through the stream network, and what happens to it on the way. Some of the key issues, as we seem them follow:

Hillslope versus channel erosion

There is growing recognition that generation of sediment from gullies and streambank erosion is probably more important than that from hillslopes for sediment budgets of large catchments. However, in contrast to hillslope erosion there are very few studies of sediment generation rates from channels and their spatial controls. Until that situation is addressed there is little basis for constructing reliable catchment sediment budgets where channel erosion is significant.

Stream bank erosion

Erosion of streambanks is conceptually quite different to hillslope erosion. Many streams eroded catastrophically immediately following degradation, with a subsequent exponential decline in erosion rate. Much of the sediment from that historical expansion is still working its way through our river systems. How do we manage that legacy?

Headwater streams

In headwater streams, where most sediment is generated, current sediment loads are more a function of the availability of loose sediment than of the power of the flows. We need to better understand the controls on that sediment generation.

Hillslope processes

Complete sediment budgets of catchments should not neglect hillslope processes though, for analysis of predominant sources measured at the catchment outlet may disguise important process interactions within the catchment. A full description of the spatial pattern of the processes within a catchment is needed to reveal how the integrated response was generated.

In-channel energy sources

Similarly, it has become increasingly apparent that in low-land river systems, in-channel primary production is a

CANBERRA TECHNICAL SEMINAR SERIES

DOES RUNOFF FROM ROADS AND TRACKS REACH STREAMS? A PREDICTIVE APPROACH.

Speaker:
Dr Peter Hairsine
CRC for **C**atchment **Hydrology**
CSIRO Land and Water

Wednesday 20 October 1999

at Conference Room
C.S. Christian Laboratory
CSIRO Land and Water
Black Mountain
Laboratory, Canberra
(Clunies Ross Street, Acton)

TIME:

10.45am for
11.00 am start

Tea / coffee on arrival.

See flyer with this Catchword for details

INDUSTRY REPORT

IRRIGATION BAY SALT EXPORT AND SALINITY MANAGEMENT

by

M. Gilfedder
L. Connell
J. Knight

Report 99/5

This new Industry Report presents the results of a CRC study of salt export from the Barr Creek catchment in northern Victoria; a large net exporter of salt to the Murray River.

The study focused on the measurement of salt export from an irrigation bay and the results have allowed assessment of the impacts of possible changes to improve farm irrigation management. In particular the report identifies the effects of reducing total irrigation volumes, and the impacts of the irrigation runoff reuse to reduce farm salt export.

In keeping with the Industry Report format and style, the report features clear and concise details of the research and outcomes with numerous illustrations and explanations.

It is available from the Centre Office for $20 by contacting Virginia Verrelli on tel: 03 9905 2704 or by email: virginia.verrelli@eng.monash.edu.au

significant energy source for aquatic food webs. In headwater systems terrestrial production appear to be important. Where the transition occurs from terrestrial to in-channel production is not clear. This sort of basic knowledge gap makes it difficult to effectively predict what changes to catchment land use do to aquatic ecosystems.

Impact of channel geometry

The propagation of material through a river system is dependent on channel network geometry. Channel geometry is also of fundamental importance to the physical and ecological restoration of rivers, because it relates the hydrological regime to the design of stable persistent channel forms. There are well developed empirical relationships that describe how channel width, depth, slope and velocity change with increasing discharge downstream. These were developed largely from humid Europe and North America. Numerous physical explanations have also been given to explain the empirical relationships, although the robustness of the relationships has never been examined. Many Australian streams show strong but predictable departures from the expected relationships. Many of our rivers experience reductions in bankfull discharge in their lower reaches, which have a major impact on hydrological behaviour. There is much need and potential for a more rigorous approach to network geometry; encompassing better empirical data, improved physical understanding, and incorporation in catchment models.

Predicting physical habitat

Large amounts of money are being spent on river rehabilitation, in spite of our current inability to predict with reasonable certainty the physical and ecological outcomes of remedial work. Because reliable methods to predict biological variables of river systems are likely to be complex and require large amounts of data to develop, a useful starting point is to develop methods to predict the character and extent of physical habitat in rivers. To enable reliable predictions of physical habitat character, data and models are needed which relate substrate character, bedform character, and channel character to variables of the flow regime and the sediment regime. These attributes of physical habitat influence distribution of macroinvertebrate fauna, fish fauna, and aquatic macrophytes. Understanding the physical habitat distribution is probably one of the first steps to modelling river ecosystems.

Impact of Europeans on river systems

Prior to European settlement most of the headwater river valleys in south-eastern Australia were swampy meadows rich in organic matter. Due to the high trap efficiency of these areas the mineral sediment yield from headwater catchments would have been quite low, and any mineral sediment is likely to have been derived from the surface soils (which contain organic matter and have lower pH than subsoils). Further, because these swamp areas are highly productive in terms of bio-active carbon, including organic acids, they will have yielded quite high organic loads. Consequently, the organic/inorganic ratio of river sediments prior to European arrival is likely to have been high. As organic-rich systems tend to have lower pHs these systems will have been a buffer toward a low pH. Nutrient supply to the river is also likely to have been dominated by organic material. Europeans land use practices resulted in these swampy meadows being incised by massive gully networks. Subsoils were exposed to erosion and there was a massive flux of mineral sediment into our rivers. This mineral flux will have rapidly altered the organic/mineral sediment ratio in the river systems. Subsoils tend to have higher pH than surface soils. Consequently the pH is likely to have increased significantly, and have remained high as a result of a continuous supply of subsoil material from the gully networks. Sources of carbon and phosphorus are also likely to have changed significantly. At present we don't know what these changes have been. If we are to restore these systems we need to understand how nutrient sources and water chemistry has been altered by European farming practices.

A challenge

These are just a few of the larger knowledge gaps! The field is wide open for a full systems approach. The challenge is to target the limited resources available to the CRC for Catchment Hydrology to deal with the most pressing, tractable and exciting problems.

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PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader: John Tisdell

Report by John Tisdell

The CRC board will shortly decide which projects will progress to the full project proposal stage. At present the water allocation program has four project proposals before the board:

- Project 3.1 will explore and develop linkages between weather, economic and hydrological models. The project will involve modifying and developing new integrated real-time and strategic models for water management, as well as manuals and support material.
- Project 3.2 will evaluate current trading rules and community acceptance of tradeable water entitlements (TWE), the notion of trading water as a chattel and current market activity. Given this background the project will develop scenarios of possible future market structures (10 years+). These scenarios will be simulated using experimental economics and game theory in conjunction with the biophysical/economic process models developed in Project 3.1.
- Project 3.3 will conduct a literature review of remote sensing and seepage models, determine river and channel exchange rates, collect and analyse remote sensing data and develop simulation loss models. This information will be added to the modeling in Project 3.1 and used in the evaluation process of proposals and scenarios arising out of Project 3.2.
- Project 3.4 will evaluate community opinion of the equity and social justice of existing water allocation and trading procedures, and evaluate community interaction in developing future trading procedures developed in Projects 3.2 and 3.1.

Diagram 1 shows the linkages between the projects. The integrative nature of the program is its strength and weakness. Critical points in research will be managed and integration points and progress strategies have been developed to ensure that the project produces rich output at all stages.

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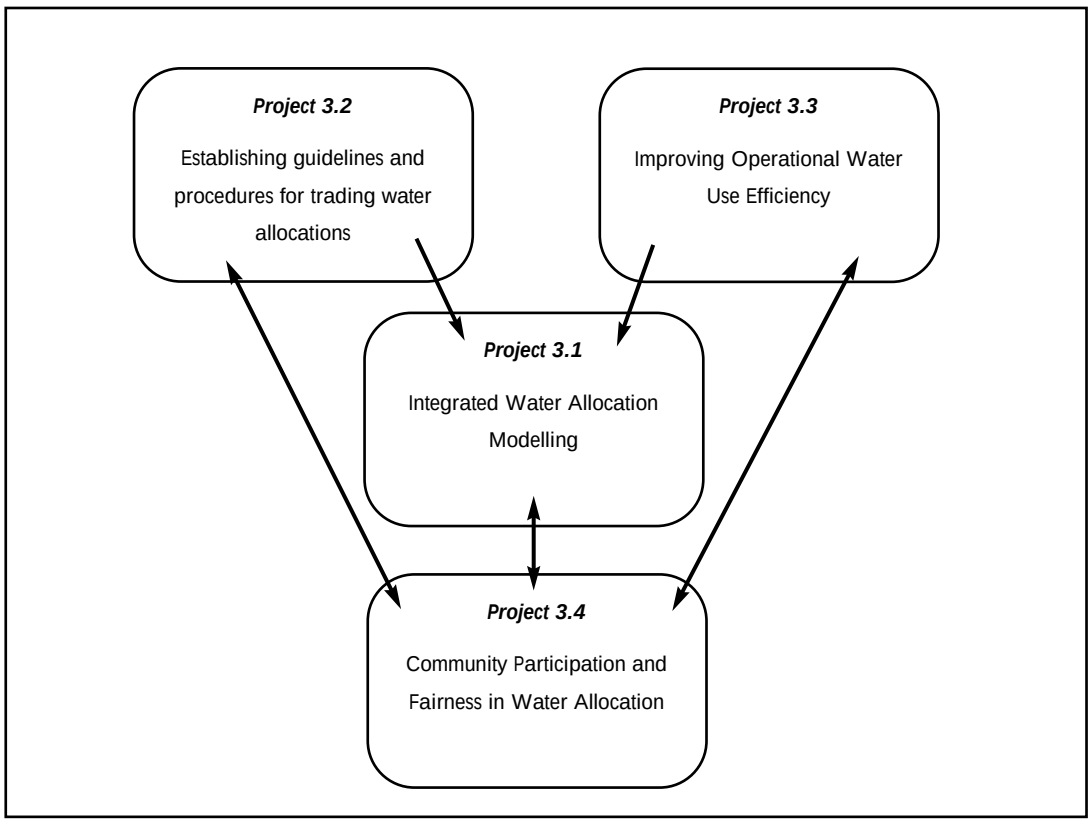

Diagram 1: Linkages between Water Allocation Projects

CANBERRA TECHNICAL SEMINAR SERIES

MODELLING AND DECISION SUPPORT FOR INTEGRATED CATCHMENT MANAGEMENT - DO WE KNOW WHERE WE'RE GOING?

Speaker:
Dr Rob Argent
Research Fellow, Department of Civil and Environmental Engineering
The University of Melbourne

Wednesday 6 October 1999

at Conference Room C.S. Christian Laboratory CSIRO Land and Water Black Mountain Laboratory, Canberra (Clunies Ross Street, Acton)

TIME:

10.45am for 11.00 am start

Tea/coffee on arrival.

INDUSTRY SEMINARS - SA and WA

CONSTRUCTED STORMWATER WETLANDS: FROM DESIGN TO CONSTRUCTION

SPEAKERS:
Assoc. Prof Tony Wong
Monash University
Urban Stormwater Quality Program Leader
CRC for Catchment Hydrology

Dr Peter Breen
Melbourne Water
Urban Water Management Project Leader
CRC for Freshwater Ecology

Alf Lester
Urban Designer and Landscape Architect LFA (Aust) Pty Ltd

ADELAIDE
Monday 11 October 1999
Start 8.45 for 9.15
Finish 12.30
Ground Floor
Enterprise House
136 Greenhills Road
Unley, South Australia

PERTH
Tuesday 12 October 1999
Start 8.45 for 9.15
Finish 12.30
WACA Ground
Nelson Crescent
East Perth, Western Australia

COST and REGISTRATION
The registration fee of $35 includes tea/coffee and cake and a complementary copy of the CRC Industry Report 'Constructed Wetlands for Stormwater Treatment' (Second edition).

Participants, however, **MUST REGISTER** for any one of the two seminars by cob Tuesday 5 October 1999. Registration forms are available by contacting Virginia Verrelli on 03 9905 2704 or email: virginia.verrelli@eng.monash.edu.au.

PROGRAM 4
URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Tony Wong

Constructed Wetlands in Urban Development – More answers to frequently asked questions

This segment is a continuation of last month's edition on answers to some frequently asked questions on the use of constructed wetlands in stormwater management and urban development. The questions were raised at industry seminars conducted in Melbourne, Canberra, Sydney and Brisbane.

The answers were prepared by Peter Breen (CRC Freshwater Ecology), Alf Lester (LFA Pty Ltd) and myself.

[Please note: Dates for seminars in Adelaide and Perth are now confirmed for 11th and 12th of October 1999 - see left.]

Question

What are the key maintenance considerations in a constructed wetland system ?

Answer

- Wetland systems are low maintenance systems and not "no maintenance" systems.
- Constructed wetlands are treatment systems designed to facilitate the removal of stormwater pollutants and thereby protect the ecological heath of the receiving waterbody
- Partitioning of treatment components in a wetland system allows for maintenance of individual components to be targeted.

These components include:
(a) Gross pollutant trap (GPT) – designed for the removal of natural litter and gross litter from human activities. Gross pollutant loading in urban catchments can be high and maintenance frequency of GPTs is often in terms of months. The maintenance operation is dependent on the type of trap and the pollutants removed can normally be safely disposed of in landfills

- gross pollutant traps with a permanent pool can cause odour problems and maintenance frequency may need to be increased;
- access for frequent and efficient maintenance operation is an important consideration in siting gross pollutant traps.

(a) Inlet zone/sedimentation basin – designed for sedimentation of coarse to medium size particles

- maintenance frequency is between 5 to 10 years, depending on the geology and level and maturity of development in the catchment;
- maintenance operation involves the mechanical excavation of deposited sediment. Vehicle access is thus an important design consideration of the inlet zone;
- deposited sediment can be disposed of in landfill. Care needs to be taken to ensure that the basin is not over-designed to provide longer than required detention periods, as longer than desired detention periods promote:
  - settling of finer material and associated contaminants (eg. metals)
  - the deposition of excessive organic material leading to possible reduced redox potential in the sediment and subsequent release of sediment bound contaminants

(a) Macrophyte zone – trapping and settling of fine particulates are promoted in this zone and typical maintenance operation of this zone includes:

- weed control and removal of dominant macrophyte species which may alter the hydrodynamic flow characteristics of the wetland;
- removal of deposited material and vegetation biomass at a frequency of between 15 to 25 years – deposited sediment may need to be disposed of as prescribed waste;
- water level manipulations may be necessary as a means of controlling excessive dominance of macrophyte species as well as promoting the rapid degradation of organic matter

Question

Constructed wetlands are often perceived as having public health and safety risks, eg. proximity of children to water, providing habitat for undesirable wildlife (snakes), increasing the risk of disease (toxicants in the waters). How can good design overcome these potential problems?

Answer

- Odour problems are often linked to an overload of organic and solid pollutants followed by the process of eutrophication. This can be addressed, to a large extent, by ensuring that the inlet zone is designed to cater for such loads, eg. by incorporating GTP pre-treatment to reduce the amount of solids entering the system. Where litter from human activities is not an issue, another alternative would be to have multiple inlet

points, which are carefully placed within the system to disperse the load entering the system over a greater area.

- Mosquito populations thrive in slow or stagnant water, so it is critical to maintain adequate flow within the wetland system and design the system so that no stagnant pools occur. Alternatively, wetland systems which rely wholly on subsurface flow do not generate mosquito problems, but may not be perceived as visually attractive to the public. Furthermore, the operation of sub-surface flow wetland may not be suited to the unsteady nature of stormwater inflows.
- Native fish species also have a role to play in keeping mosquito populations in check. This reflects the need to encourage biodiversity of flora and fauna within a constructed system, as it will, over time, become more robust and self-sustaining.
- There will always be a risk factor where water is in close proximity to children, no matter how deep or shallow it may be (a puddle or Sydney Harbour)! Reducing this risk can be achieved by controlling access to the waters edge through the following ways;

  1. Planting to water's edge to discourage access
  2. Planting within water's edge to discourage access
  3. Placement of pathways and clearly identifiable points (eg. jetty, ramp or beach) where access is permitted and safe
  4. Ensure that accessible water zones have clear sight lines from surrounding open space areas
  5. Adequate signage highlighting safety issues
  6. Use of shallow edge profile where access to water's edge is encouraged

- Snake populations can be kept in check by encouraging biodiversity as discussed above. Otherwise this issue can be controlled to some extent by maintenance at the appropriate time of year.

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PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM MCMAHON

Report by Francis Chiew and Graham Mills

It is likely that one of the research areas in the climate variability program will focus on the testing of numerical weather prediction models and improving the surface hydrology in the models. The research will be carried out with a significant in-kind contribution from the Bureau of Meteorology. Graham Mills provides a background here of the numerical weather prediction model development in the Bureau of Meteorology Research Centre.

Operational models for weather prediction

The Bureau of Meteorology Research Centre develops the operational numerical weather prediction (NWP) models used in the Bureau of Meteorology. The Bureau runs a hierarchy of NWP models – global, regional, and mesoscale.

Global and regional models

The global model, GASP, covers the whole globe with a grid spacing of around 75 km. This global model is run twice per day to 8 days, and provides medium range forecast guidance. A regional model, LAPS, has a grid resolution of around 37 km, and is run twice per day to 48 hours, and is intended to provide short-range guidance to forecasters on flow over the Australian region. A separate version of the regional model, TLAPS, is designed to cover the tropical latitudes on the Australian region, and includes initialisation techniques to improve its prediction of tropical weather systems. TLAPS has similar resolution to LAPS. Both regional models are "nested" inside the global forecast, so that the lateral boundaries of these limited area models are updated by the time-tendencies of the larger-scale model.

Mesoscale or "whole of Australia" models

Nested inside the regional models are the so-called mesoscale models, which operationally are about to be upgraded to around 12.5km grid spacing. This model will cover the whole Australian continent and immediately surrounding waters, and is intended to provide forecasters with the detailed spatial and temporal evolution of flow-fields in their area of interest. This "meso-LAPS" model is run twice per day to 36 hours, and shows exciting promise in its ability to resolve the detailed structure of clod fronts, small-scale, intense low pressure systems, and topographically modified flows.

NEW TECHNICAL REPORT

FOREST MANAGEMENT FOR WATER QUALITY AND QUANTITY PROCEEDINGS OF THE SECOND FOREST EROSION WORKSHOP - MAY 1999

by
J.Croke
P.Lane

Report 99/6

This report contains the Proceedings of the Second Erosion in Forests Workshop held in Warburton in May 1999. This volume of short papers and abstracts reflects the wide range of research approaches and tools currently used to measure and model the impacts of timber harvesting activities, including road construction and vegetation changes, on water quality and quantity.

Copies available for $20 from the Centre Office.

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

NEW VIDEO

EROSION IN FORESTS FIELD TOUR WARBURTON, VICTORIA MAY 1999

CRC VIDEO 99/3

This new CRC video presents the field tour in the Noojee State Forest undertaken as part of the recent 'Second Erosion in Forests Workshop'.

The video includes presentations by forest managers and researchers as well as questions from participants and group discussion.

Copies are available for $20 from the Centre Office.

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

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"Vertical" aspects of models

These numerical weather prediction models all have 29 levels in the vertical, spanning the full depth of the atmosphere. The regional and mesoscale models have a concentration of levels in the boundary layer to better resolve the processes occurring there, while the global model extends to the high stratosphere. The models numerically solve the equations of motion and the thermodynamic equation on a three dimensional grid, and also include "physical parameterisations" of those processes which cannot be explicitly resolved by the model equations. These processes include short and long wave radiation, and the interaction of these wavelengths with clouds and the atmosphere, large-scale condensation processes, moist convection, and planetary boundary layer processes. The boundary layer scheme in the regional model includes a 4-layer soil temperature and water transfer model, and includes land use and vegetation type in its modelling of water movement through the atmosphere-soil interface. A common suite of physical parameterisations is used in the global and the regional models, and this is also used in the climate modelling activities in BMRC.

Specifying initial states

These models cannot accurately predict the future state of the atmosphere without accurately specifying the initial state. To this end temperature, wind components, and moisture variables must be specified at each gridpoint in three-dimensional space, as well as surface pressure, temperature, and surface properties at each gridpoint. Short-range (typically 6-hour) forecasts from a previously-specified initial state are used as a "first guess" for the next analysis. In this analysis, the first guess is adjusted to match all observations in a three-dimensional multivariate adjustment, in which observational errors and error covariances, as well as the model error covariances are incorporated in order to obtain an "optimal" fit of all data. Global data is available in Melbourne from the Global Telecommunications System, and includes surface observations from manned stations, from automatic weather stations, ships, and drifting buoys. Temperature and moisture profiles through the atmosphere are available from radiosondes and from radiometric measurements from orbiting satellites. Wind profiles are obtained by radar tracking of balloons, by tracking of cloud features from sequences of geostationary satellite images, and from aircraft. Optimally using these inhomogeneously distributed data of different types and error characteristics in data assimilation schemes is a complex and challenging task.

Accuracy of models

The increasing accuracy and spatial resolution of the current generation of NWP models is leading to a new paradigm for the use of this material by forecasters. In the past, the model predictions have been presented to forecasters in a form similar to the mean sea level pressure "weather maps" that one sees in the media, and forecasters would subjectively interpret the forecast from this guidance. However, the accuracy of the models is now such that direct use of wind, temperature and precipitation forecasts from the models by the forecasters is beneficial.

Applications

In research the meso-LAPS model is being run at 5km resolution, and variations at the city-scale are being modelled. Applications to air quality modelling, quantitative precipitation forecasts, fire weather forecasting, and hydrological applications are being actively pursued.

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PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by John Gooderham

Assessing an environmental flow: Will the Campaspe river be half full, or half empty?

Project W2: Stream Restoration has been involved for the last year in collaborative work with the CRC for Freshwater Ecology, assessing the physical aspects of an environmental flow regime designed for the Campaspe River in Northern Victoria (see *Catchword* No.67 November 1998). The aims of this project are to quantify the hydrological changes due to the environmental flow regime, and also to translate these changes into observations of habitat or biotope inundation within the river. This information will then be used by ecologists at the CRC for Freshwater Ecology who are testing hypotheses about the effects of the new environmental flow upon the ecology of the Campaspe River. Our work is to test the grounds for hydrological optimism. Under the environmental flow regime, will the Campaspe River be half full, or half empty?

Regulation of the Campaspe River

The Campaspe River has been regulated since the completion of Lake Eppalock in 1962. Irrigation has effectively reversed the seasonal hydrology of the Campaspe River downstream of the lake, reducing the normally high flows of winter to almost nothing, and replacing the naturally drier spells throughout the year with constant irrigation flows. The environmental flow regime was designed in 1998, and will be implemented as soon as a trigger water level of 200GL is reached in Lake Eppalock. It is hoped this will alleviate some of the stresses the current winter flow regime places upon the instream ecology, by reinstating 25% of the natural flow within the river. The success of the environmental flow will eventually be judged using a long term biological survey run by the CRC for Freshwater Ecology, but the modeling work done as part of this project will allow the physical effects of the environmental flow to be used as a basis for ecological hypotheses.

Hydrological comparisons

The first block of work for this project was completed by Goulburn-Murray Water, and involved the generation of simulated flow data for three flow regimes at a couple of reaches on the Campaspe River. Flow data under regulated conditions (from 1974 to 1997) was combined with volumes in Lake Eppalock to derive a natural flow regime (assuming the absence of Lake Eppalock), and an environmental flow which was calculated as 25% of the natural flow (providing the resources within Lake Eppalock exceeded 200GL). Comparing the three flow regimes using these modeled discharge records shows winter as the season during which the environmental flows have the most effect.

Ecological perspectives

Daily time series data is not however an end in itself. Volumes of water are notoriously difficult to interpret from an ecological perspective, and it is only when these volumes are associated with the river bed, and the biotopes within it that they become ecologically meaningful. This project uses a combination of hydraulic modeling and habitat surveys to convert the daily discharge data to daily Biotope Availability Graphs (BAGs). These allow ecologists to look at discharge data in terms of the biotopes the water is covering, rather than in terms of the amount of water present in a system. Some of the biotopes addressed in this study include snags, submerged macrophytes, emergent macrophytes, and terrestrial ground cover. Snags are a particularly important biotope within the Campaspe River and are the main focus of the CRC for Freshwater Ecology macroinvertebrate monitoring program.

Preliminary results

Preliminary results show that the Environmental flow regime will restore the availability of different biotopes to different extents. Biotopes that occur relatively low in the channel, such as most snags and submerged macrophytes will almost be returned to natural conditions, while terrestrial ground cover on the floodplains benefits much less from the environmental flow regime. Intermediate biotopes such as the emergent macrophytes will have about half of their natural inundation restored over winter. So whether the Campaspe River will be half full, or half empty, depends upon the biotope you choose to look at.

STREAM CONFERENCE PROCEEDINGS

The Proceedings of the Second Australian Stream Management Conference held in Adelaide earlier this year are available through the CRC Centre Office for $95.

The two volumes (750+pp) consist of over 150 papers covering all aspects of stream management.

Please contact Virginia Verrelli on 03 9905 2704 to order your copy.

SECOND EDITION OF INDUSTRY REPORT PUBLISHED

MANAGING URBAN STORMWATER USING CONSTRUCTED WETLANDS

by

Tony Wong
Peter Breen
Nicholas Somes
Sara Lloyd

Report 98/7

Over 900 copies of this successful Industry Report have been sold resulting in a Second Edition. This new edition includes a new section, Appendix A, which answers a number of common questions on the use of constructed wetlands in stormwater management.

Copies available from the Centre Office.

COPIES ARE AVAILABLE OF VIDEOS, REPORTS AND WORKING DOCUMENTS FROM: THE CENTRE OFFICE AT $20 PER COPY UNLESS OTHERWISE NOTED AND CAN BE ORDERED BY CONTACTING: VIRGINIA VERRELLI ON TEL (03) 9905 2704 or FAX (03) 9905 5033 EMAIL virginia.verrelli@eng.monash.edu.au

The two photos above illustrate some of the likely benefits of environmental flows at a typical site in the Campaspe River during winter. The top photo shows a flow of 10 ML a day, which leaves many instream biotopes (river habitats) exposed. Regulated winter flows are commonly much less than this. The bottom photo shows a flow of around 320 ML. A flow of this size will occur more frequently during winter as a result of the environmental flow regime discussed. Biotopes covered by this flow include snags, gravel bars and macrophytes (instream vegetation).

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COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

Report by David Perry

The Flow on Effect - September 1999

Seeking Best Practice in Communication and Adoption

Involving end-users

Current best practice in research transfer and adoption requires the involvement of end-users throughout the life of a research project. This philosophy raises some important questions about how to involve the end-user, particularly in the CRC where end-users for our projects may range from farmers to researchers. The Centre has a proven track record of effective involvement with end-users, due to the strong commitment of the CRC research and industry parties. Although the CRC is not resourced sufficiently to liaise with individual farmers or Landcare groups, our strategy of forming close relationships with representatives of our end-users through existing CRC party networks, peak advisory bodies and industry groups has been successful.

Over the next ten weeks however, program leaders will be working up the first set of new CRC projects in detail. With this in mind, it is worth reflecting on how we might continue to deliver a best practice communication and adoption program involving the end-users of our research.

Some Elements of Best Practice

Last year the Murray-Darling Basin Commission (MDBC) asked Integra Pty Ltd (a consultancy offering services in facilitation, communication and training) to review the current practices, strengths and weaknesses in the transfer and adoption of their Strategic Investigations and Education (SI&E) Program projects. The 'Transfer and Adoption Scoping Study - Final Report' (September 1998) details a range of recommendations specifically for the MDBC, but it also describes what Integra identified as current best practice in transfer and adoption during the scoping study.

Key Questions

Below are some key questions that I consider should be asked during research planning based on Integra's best practice elements. I plan to use these questions as a framework to assist the CRC project teams to develop a communications and adoption plan for each project.

• *Who are the end-users?*

Identifying the end-users is a critical step. It requires careful thought about the wide range of people who may implement the research outcomes. 'End-users' should also include those people with a vested interest in the research outcomes although they may not apply them directly.

• *What is the end-user's environment?*

A research team must understand the limitations and benefits of the environment in which the end-users will implement the research outcomes. This means the team must clearly understand the end-users current level of knowledge, experience and preferences for learning and decision-making. This will ensure the final products are relevant to the 'adoption environment'.

• *How can we create ownership and anticipation?*

The project's outcomes must be communicated and delivered in the context of the current issues facing the end-user. Dialogue with end-users during the research will assist in creating a sense of ownership and expectation of the value of the research outcomes thereby providing a more fertile environment for adoption. It will also ensure that the potential research products move with the changing environment of the end-user.

• *What are the best mechanisms to reach end-users?*

Once the project team has a sound understanding of the product or output (including its value and meaning to the end-user and its potential impacts or benefits), it is important to choose the most effective way to communicate the research outcomes. The process selected should reflect the preferences of the end-users rather than the preferences of the research team.

• *What are the critical steps to effective adoption?*

Once the answers to the above questions have been formed through dialogue with the end users a 'path to adoption' may be sketched. It is important to ensure that the overall process, including the messages, media used and anticipated research outcomes are in context and relevant to the end-user environment. This step also allows for a simple 'risk analysis' to determine potential threats to the adoption process.

• *What opportunities exist for a collaborative approach to communication and adoption?*

There are many existing communication networks (government and community) that can assist during the life of the project to provide input as to how to integrate and deliver research outcomes in a form readily understood and accessible to the end-users. During the transfer process these networks can play a critical role.

THE 10TH ANNUAL JACK BEALE WATER RESOURCES LECTURE

THE CHALLENGES OF HYDROLOGICAL RESEARCH AT CATCHMENT SCALES

by

Professor Russell Mein
Director
CRC for Catchment Hydrology

Tuesday, 19 October 1999 at 8:00 pm
Manning Clark Lecture Theatre 1
Australian National University, Canberra

Most of the research on hydrological processes in catchments has concentrated on small scales, frequently not relevant to the issues in catchment management. This lecture reviews the past successes of hydrologic research in applications to catchments and identifies the challenges in land and water management.

This lecture is FREE and interested members of the public are invited to attend.

BOOKINGS ARE NOT NECESSARY

Inquiries to Water Research Foundation of Australia
Tel 02-6249.0651
Email: wrfa@cres.anu.edu.au

Canberra chapter of RBMS?

ACT members of the River Basin Management Society (RBMS) are holding an inaugural meeting to be held at:

the Conference Room
CSIRO Division of Land & Water
Black Mountain, Canberra

commencing at 6pm on Tuesday 12th October.

The purpose of the meeting is to find out if people are interested in forming a chapter of the society in the ACT. The meeting also provides the opportunity for people who are not members to find out more about the society and join. People in surrounding NSW are also invited to attend.

For further details contact

Leanne Dempsey, Senior Communication Officer
CSIRO Land and Water Division
GPO Box 1666
Canberra ACT 2601
02 6246 5717
E-mail:
Leanne.Dempsey@cbr.clw.csiro.au

• *What opportunities can we create to learn together?*
During the project life there are opportunities to provide information to end-users and to allow end-users to digest the implications of the research's progress and place it into a context. Research teams can take advantage of this to review their communication style and gain more understanding of the end-users environment.

• *How can we make it easier for end-users to adopt our research outcomes?*
To be effective the process of transfer and adoption should consider the capacity of the end-users to make the desired change in practice. This involves understanding potential resistance to adoption including financial, practical, behavioural and technical factors. The communication and adoption process must enhance and support (step by step) the end-users capacity to understand and implement the research outcomes.

• *What difference are we making? How can we improve adoption?*

Ongoing monitoring and evaluation of the team activities throughout the project will ensure that time spent on communication and adoption is effective and continually improving.

• *What types of activities will catalyse and reinforce the desired change in practice and level of adoption?*

Successful communication will include a strategic framework of broad level activities designed to publicise the messages, products and changes intended. For example, educational and media activities can assist in setting the agenda for public debate, incentives and penalties may be appropriate to reinforce the message and other activities can influence policy and remove impediments to change.

• *What must be put in place over the longer term to ensure continuity and ongoing commitment to the communication and adoption process?*

A collaborative approach to communicating the research outcomes from the beginning will engender support from end-users and others with a vested interest to ensure that the adoption process maintains momentum allowing the researchers to continue their focus on research.

Consideration of these questions provides a sound framework for the planning and delivery of our communication and adoption activities and will determine the CRC's major performance indicator – the level of adoption of our research outcomes.

Please note: The MDBC report 'Transfer and Adoption Scoping Study - Final Report' is available by contacting Rosemary Purdie – Director, Natural Resources Evaluation and Communications, at the Murray-Darling Basin Commission office in Canberra. Tel: 02 6279 0117 or email: rosemary.purdie@mdbc.gov.au

David Perry
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UPDATE EVAPOTRANSPIRATION MAPPING PROJECT

We regret to advise that the publication of the evaporation maps has been delayed, likely for some months. On the virtual eve of printing the maps, we discovered an error in the computer program used to generate them. This error occurred after our quality assurance processes, including a comparison with Morton's original program to ensure identical output results, and hence escaped earlier detection. We are glad that the problem was found prior to distribution, and are now investigating options to re-do the maps. I'd like to thank Dr Roger Jones and Dr Nick Austin for help with identification of the error.

To those who are waiting on the maps, the CRC apologises for this delay; you can be assured that we will do our best to expedite the revision.

(PROJECT LEADER: Q.J.Wang)

CRC PROFILE

Our profile for September is Rae Moran.

Rae Moran

Rae is the Senior Hydrologist in the Catchment and Water Resources Section of the Catchment Management and Sustainable Agriculture Division of the Victorian Department of Natural Resources and Environment. To continue with the long titles, the specific unit she works in is called 'Surface Water Allocation and Management', which has the responsibility for developing and implementing a system of formal and tradeable entitlements to water throughout the State. Her major roles include managing the State's streamflow monitoring network, and ensuring appropriate drought preparedness and response throughout the Victorian water sector. This latter role has kept her very busy over the past few years given that many parts of the State have experienced significantly below average rainfall over the last three years.

Rae has been with the Department, in its various 'incarnations', since 1986, when she joined the then Department of Water Resources to work in the Salinity Unit in the early days of developing a salinity control strategy for Victoria. Prior to that time, she spent ten years working in the Catchment Studies Section of the then Melbourne and Metropolitan Board of Works on their forest hydrology research program. In fact, she was initially employed by Dr John Langford, the Chairman of the CRC for Catchment Hydrology. The work undertaken by the Catchment Studies Section involved 18 experimental catchments in the Great Dividing Range near Healesville and had the aim of determining the effect of timber harvesting in E. Regnans forest on water quantity and quality. It was with great interest that Rae saw this work built upon and expanded by the Forest Hydrology Program of the first-round CRC.

Rae's initial training in hydrology occurred in the context of completing a Master of Arts degree (in physical geography) at Canterbury University in New Zealand. She majored in Climatology, and spent her Master's thesis year doing energy balance studies (in particular, looking at the spatial variability of soil heat flow) in a small valley in the Southern Alps near Arthurs Pass. She subsequently embarked upon a PhD (in Climatology) at Canterbury University, but abandoned this to move to Australia. After commencing work with the MMBW, Rae undertook further studies in the form of a Master of Engineering Science degree at Monash University. Her thesis involved a review of techniques for measuring forest evaporation and the application of Morton's Model to E. Regnans forested catchments.

Having had a keen interest in the CRC for Catchment Hydrology from its inception, and having been directly involved from time to time (as the 'necessary' woman) in various interview panels for positions within the CRC, Rae is very pleased to now be DNRE's Board Member on the CRC. It is a particularly exciting time given that the next seven years research program is currently being developed. Rae's particular interests are in the new Sustainable Water Allocation Program and in projects in the Land-Use Impacts on Rivers Program which will further our ability to predict the impacts of land use change on catchment water yields.

Rae believes that the research undertaken by this CRC, and the links with other participating organisations, are invaluable in improving the knowledge base needed for effective resource management decisions. One of the major challenges faced by Rae is to ensure appropriate coordination of the inputs to the CRC from the many relevant 'units' within a very large Department. Another main aim is to get research outcomes well-communicated throughout the organisation and translated, where appropriate, into effective on-the-ground outcomes.

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NEW TECHNICAL VIDEO

CATCHMENT WATER BALANCE A SIMPLE APPROACH

Presented by

Dr Lu Zhang
CRC for Catchment Hydrology
CSIRO Land and Water

CRC VIDEO 99/4

Results from over 240 catchments in many parts of the world, including Australia, show that for a given forest cover, there is a good relationship between long-term average evapotranspiration and rainfall.

This seminar describes the development of a simple two-parameter model that relates mean annual evapotranspiration to rainfall, potential evapotranspiration, and plant available water capacity.

WHERE ARE THEY NOW?

Report by Grace Mitchell

Where is Grace Mitchell? Well, do you know where Highett is? During working hours I can usually be found in my office at the Highett site of CSIRO Division of Building Construction and Engineering.

After completing my PhD in early 1998 I spent some time working for CEAH at The University of Melbourne. Primarily, I spent my time developing a water quality screening model for the Port Phillip catchment, which we called FILTER. The software development was funded by Melbourne Water, the Department of Natural Resources and Environment, the Victorian EPA, and the Port Phillip Catchment and Land Protection Board.

Rob Argent and I gamely took up the challenge of providing staff and managers working in these organisations with a piece of software which had both GIS functionality and a user friendly interface. The software also had to model the TP, TN, and TSS loads generated from the 9950 km^2 Port Phillip catchment. Developing the model algorithm, integrating GIS data with hydrographic and water quality data, and providing an intuitive user interface and documentation kept me busy for the rest of 1998.

Developing FILTER was a fun and satisfying project and a good antidote to completing a PhD. This is because it was a relatively short project, with a strong emphasis on a rapidly applicable product. It also had the involvement of a number of staff in the supporting organisations who had a keen interest in the results. And I learnt heaps. One thing I learnt in particular was the value of work-shopping a piece of software throughout the development phase in order to make the end-user feel like they own the product. After all, it was their custom-built water quality screening model.

In January of this year I took up a job with CSIRO to join their Urban Water Program. I was brought in to work on urban water balance modelling and life cycle costing.

Some of you may recall that my PhD was on urban water balance modelling. It has been good to use so much of my PhD research in the context of a larger research project. The software I developed for my PhD, called Aquacycle, has provided a strong base for the water and contaminant balance modelling work being conducted in the Urban Water Program.

I am also researching the area of life cycle costing of urban water services. This is an issue that I think must be tackled before we can have well informed debate about the true cost of traditional and alternative urban water supply and disposal approaches.

In my spare time I have been plugging away at completing the development of Aquacycle in its own right. The software and user manual will be beta tested shortly before it is released by the CRC as a beta version.

Outside work I have spent plenty of time doing those things I was craving to get time for when writing up my PhD. Although, I still drink too much coffee!

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WORKSHOP ON

CONTINUOUS SIMULATION FOR DESIGN FLOOD ESTIMATION

Monash University, 23-24 Nov 1999

***Main presenter:* Dr Walter Boughton**

This workshop is intended for people experienced in flood design who are interested in applying the latest developments in flood estimation methodologies. The continuous simulation approach developed by Dr Boughton in association with the CRC allows estimation of design floods from frequent events to floods of 1 in 2000 AEP.

Please contact Virginia Verrelli at the Centre Office on 03 9905 2704 to register your interest. Further details will be included in the October issue of *Catchword*.

WATER VICTORIA EMAIL (WAVE) LIST

The WaVE list (formerly known as VicWater) has been set up to facilitate the discussion of water related issues.

The list is free and can be used to advertise seminars, workshops, job vacancies, to solicit information on any range of water related topics or any other appropriate use. Posters should keep matters relevant to the state of Victoria, Australia. The list is closed, which means that only those on the list can post a message, but it is open for anyone to subscribe or unsubscribe as desired.

To subscribe, send subscribe to: wave-request@eng.monash.edu.au

To send a messages, send an email to: wave@eng.monash.edu.au

The list is maintained by Peter Hill at Sinclair Knight Merz. Any queries should be directed to: phill@skm.com.au.

WaVE is supported by the Victorian Water Engineering Branch of the Institution of Engineers and the CRC for Catchment Hydrology.

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

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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: Hydro-Electric Corporation, Tas • State Forests of NSW • SA Water

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