NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 79 DECEMBER 1999

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

Inside...

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

Research – expectations and realities

Forward planning is a necessary activity for any organisation wanting a future. For the CRC for Catchment Hydrology, the identification of national water issues, for which research is likely to have positive benefits, has been given high priority from day one. The matching of the Centre's research to the industry needs has been an important factor in its success, including the award of a second seven-year term of Commonwealth funding under the CRC Program.

Here, it is relevant to recall the outcomes of our first Future Issues Workshop, held in October 1994. Then, fifteen participants, representing major interest groups, organisations, and research bodies in land and water management were invited to present their top five issues related to catchment hydrology. They were asked particularly to nominate issues that they expected to be dominant in five years time (ie 1999). The intention was for the CRC to conduct research to provide a knowledge base to help managers when they were most likely to need it.

For the record, the top five issues (after grouping the 60-70 individual nominations together) were:

- salinity
- environmental flows
- nutrient and sediment transport
- holistic views of catchments
- knowledge distribution and exchange

(The workshop produced much more detail on the specific 'research gaps' for each of them.)

Most readers of *Catchword* would agree that our 1994 workshop participants were pretty successful in identifying the issues high on the water management agenda for five years from then; ie. now. The release of major studies on the salinity hazard in the Murray-Darling Basin, the increasingly political issue of environmental flows(eg Snowy River), and strong acceptance of the impact of nutrients and sediment on water bodies like the Gippsland Lakes are testament to the first three.

For the other two top issues, interest in the holistic (or whole-of-catchment) approach is growing rapidly, particularly aspects such as water supply quality (eg Sydney's water supply system), and for the impact on yield and salinity from changes in land use. 'Knowledge distribution and exchange' was an interesting nomination, stemming from the perceived uncertain flow of useful information from those who have it to those who need it; there is no doubt that much has improved in this area in the five years from 1994.

It is also certain that the CRC's research program - modified in 1996 to give more focus to industry issues raised in the workshop - has provided substantial knowledge to help land and water managers with the problems of today. I should add that many other research groups have also contributed to the knowledge base; they and others have helped to communicate water issues to the wider community.

An important point to make here is that, while the targeted research programs of the CRC have delivered outcomes of great benefit to its Parties (justifying existing Parties to sign up for a further seven years, and new Parties to join), there will almost never be complete answers to environmental problems. Catchments change, and socio-economic and political impacts add important variability. Research has to continue, and to be adaptive, to address emerging 'hot spots'.

Which brings me to an issue for the CRC. The planning time-frames for land and water managers are shortening; long-term issues are shadowed by those of the here-and-now. The pressure is on the CRC to produce answers quickly, sometimes before proper evaluation of research results is made.

The point to be emphasised is that good research requires planning, an awareness of existing knowledge, and a program of work to meet its objectives. It also takes time, an aspect that has to be factored into the expectations of research users. The CRC has objectives to be met over this seven-year funding period, and is near to developing a phased program of work to achieve them. We'll be keeping you abreast of progress.

The staff of the CRC join me in wishing all readers of *Catchword* a merry Christmas, and a satisfying new year. Our next edition is next century (February 2000).

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PLEASE NOTE...

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PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Rob Vertessy

News on the project scoping process

The team for Program 1: Predicting Catchment Behaviour ,is now putting the final touches to the agreements for Project 1.1 (the catchment modelling toolkit) and Project 1.2 (scaling procedures for process-based models). Project 1.3 (uncertainty in hydrologic data and modelling) is undergoing further development and is being deferred until we can cement some collaboration with the Coastal Zone CRC on this topic. Rob Argent and Rodger Grayson have done a great job working up the agreements for Projects 1.1 and 1.2, respectively. I also want to thank the many individuals from the research and industry parties who injected their ideas into the project development process. I believe that our project portfolio includes a powerful mix of exciting and challenging science, and products that will significantly improve catchment management when applied by our industry parties. Final drafts of the project agreements will be circulated to all of the participating Parties before the end of the month for approval, so that we can start work in early January 2000.

Associated project being planned

Following a request from the South East Queensland Regional Water Quality Management Strategy (SEQRWQMS), Rob Argent and I are designing a project aimed at the development of a modelling system for the Brisbane River catchment. The proposed project has similar objectives to our modelling toolkit project (Project 1.1), though it will be framed around the catchment modelling needs defined by the SEQRWQMS. Tasks include (i) integration of component models with differing structures, complexity and spatio-temporal scales (ii) the design of interfaces to permit complex landuse scenarios to be formulated, and the model output from them to be easily understood. More on this topic in the next issue of *Catchword*.

Update from the IUFRO Forests and Water Task Force

In early November, the CRC for Catchment Hydrology hosted a workshop for the Forests and Water Task Force of the International Union of Forest Research Organisations (IUFRO). Task force members from our CRC include myself, Jacky Croke, Peter Hairsine, and Richard Silberstein. The purpose of the workshop was to finalise planning for a book which the Task Force is writing on behalf of IUFRO. Entitled 'The State of the Art in Forest Hydrology', the book will review our understanding of forest hydrological science across a broad range of fronts. These include water yield, erosion, salinity, water quality, remote sensing, forest water use, catchment nutrient cycles and hydroecologic modelling. Each book chapter (17 in all) is being prepared by one or more world experts, so we are confident that it will be highly regraded when complete in August, 2000.

Postcard from Geelong

On December 1, Jacky Croke and I participated in an expert panel to discuss the hydrologic impacts of forestry. Held at Geelong, the panel was assembled by the Commonwealth Government as an adjunct to the Regional Forest Assessment for Western Victoria. A key focus of the meeting was logging in the Otway Ranges and the likely water yield and quality implications of this. There was vigorous debate between pro-logging and environmental groups on this issue and it attracted considerable local and state media attention. It was satisfying to discover that the debate now significantly draws on CRC for Catchment Hydrology research results. In particular, the two Industry Reports from the former Forest Hydrology Program seem to have been well received.

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PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Peter Hairsine

Precis of new core projects

Here is the summary of the new core projects in Program 2: Land-use impacts on rivers. The status of each project is provided following the instructions of the November 1999 meeting of the CRC Board. Participation, focus catchments and resources for these projects are subject to further negotiations.

Project 2.1 – Sediment movement, water quality and physical habitat in large river systems

This project is to be run jointly with the River Restoration program. The project concerns the generation, movement and storage of sediment within stream networks and its consequence for the physical habit of those streams. As Jon Olley and Ian Prosser put it so well in their article in September 1999 edition of *Catchword*, "rivers are not conveyor belts".

The questions this project will address include:

- from where in a catchment are sediment and nutrients sourced;
- where downstream do they impact on the physical habitat;
- what are the rates of adjustment of rivers to land use change;
- what changes are occurring to the channel morphology and bed substrate; and
- are rivers approaching a new ecologically acceptable state without intervention.

Project leader : Dr Ian Prosser CSIRO Land & Water Canberra, tel: 02 6246 5830
email: ian.prosser@cbr.clw.csiro.au

Status: It is planned to commence this project in March 2000. Some aspects of the project to run jointly with the CRC for Freshwater Ecology will be delayed until co-funding is in place.

Project 2.2 Managing pollutant delivery in dryland upland catchments

The project addresses the delivery of sediment, nutrients and salt from diffuse sources on the hillslope to the stream edge. This project will address the following knowledge gaps through the analysis of existing data and the development of modules for the modelling toolkit as constructed in program 1:

- Australia does not have an established methodology for predicting the delivery of sediments and sediment-attached pollutants to the stream edge
- There is a clear gap in our salinity knowledge concerning the wash-off of surface salinity to streams.
- Runoff predictions required for pollutant transport predictions are not well linked with storm patterns at a catchment scale

Project leader: Peter Hairsine CSIRO Land & Water Canberra, tel: (02) 6246 5924 email: peter.hairsine@cbr.clw.csiro.au

Status: It is planned to commence this project in January 2000.

Project 2.3 Predicting the effects of land use change on catchment water yield

The overall objective of this project is to predict the regional scale impacts of afforestation and other land use changes on mean annual and seasonal catchment water yield, groundwater recharge, and stream salinity. Specific objectives are:

- Develop a regional scale model for predicting the impacts of vegetation and other land use changes on mean annual catchment water yield
- Develop innovative procedures for parameterising landscape water storage and permeability using current and new forms of land resource data
- Develop a framework for estimating groundwater recharge under different land use and soil conditions. Produce catchment recharge maps incorporating land use, soil, vegetation, and climate conditions
- Develop models for predicting seasonal variations in catchment water yield under changed land use conditions for inputs to water allocation analysis

In the second phase of this project the team plans to investigate the salinity consequences of such changes in water yield.

NEW INDUSTRY REPORT

MANAGING SEDIMENT SOURCES AND MOVEMENT IN FORESTS: THE FOREST INDUSTRY AND WATER QUALITY

by

Jacky Croke
Peter Wallbrink
Peter Fogarty
Peter Hairsine
Simon Mockler
Bob McCormack
Jim Brophy

Report 99/11

This report presents an overview of CRC research findings on the management of sediment sources and delivery pathways and the effectiveness of best management practices.

This report is relevant anyone involved in the forest industry, shire councils, road planning and catchment water quality management.

Copies available from the Centre Office for $25.

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.

Project leader: Dr Lu Zhang CSIRO Land & Water
Canberra, tel: 02 6246 5802
email lu.zhang@cbr.clw.csiro.au

Status: It is planned to commence this project in January 2000.

Project 2.4 Water quality impacts on regional changes in land use and water management in irrigation areas

The objective of this proposed project is to provide managers and policy makers in the Murray-Darling Basin's major irrigation regions with a systems approach to water quality which allows them to make better informed decisions and evaluate long-term outcomes at regional and catchment scales for the complex and inter-connected issues of:

- water allocations and transfers
- conjunctive use of surface and groundwater
- use and disposal of drainage waters
- sustainable land use
- salinity control whilst managing nutrients

Project contact: Alfred Heuperman, Victorian Department of Natural Resources and Environment, Tatura,
tel: 03 58335246
email: alfred.heuperman@nre.vic.gov.au

Status: This project is to be deferred until the second three years of projects. A further scoping phase is to be conducted in the interim. This scoping is to be undertaken by Alfred Heuperman in collaboration with other interested Parties.

Project 2.5 Riparian zone transport and transformation of nitrogen

This project will address the following research questions:

- What are the important factors influencing sub-surface fluxes of nitrogen through the riparian zone?
- What reduction in nitrate delivery to streams can be achieved by having intact riparian zones in agricultural catchments?
- What is the denitrification potential of riparian soils and how does this vary spatially and with depth, and between soil types?
- What is the role of organic carbon in influencing nitrogen transformations in the riparian zone?
- Is vegetation necessary for effective reduction of nitrogen fluxes in riparian zones?
- What is the relative importance of trees versus grass, and what are their important characteristics concerning nitrogen removal?
- What other transformations of nitrogen are important in riparian zones and how do these affect net nitrogen removal?
- How wide a riparian buffer is necessary to effectively reduce nitrogen fluxes?

Project leader: Dr Heather Hunter, Queensland Department of Natural Resources, Brisbane, tel: (07) 38779637
email: heather.hunter@dnr.qld.gov.au

Status: This project will be delayed until co-funding arrangements with other CRCs are in place.

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PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader: John Tisdell

Report by John Tisdell

Trading water allocations

Part of the research proposed in the Sustainable Water Allocation Program over the next few years will involve using game theory and experimental economics to evaluate possible trading rules and procedures for the next decade. Project 3.2: 'Establishing guidelines and procedures for trading water allocations' is aimed at providing industry parties with the opportunity to strategically evaluate possible trading rules and procedures for water markets in the year 2010. By this time water markets will most likely have matured, and market knowledge will have increased. As a result water entitlements will have become a chattel of trade, possibly in a similar way to cotton in spot or futures trading markets.

Project structure

The project will be conducted in three phases. Phase 1 will evaluate current market activity and trading rules. Phase 2 will develop, in conjunction with industry and interested parties, rules and procedures for trade in mature water markets in the focus sub-catchments. Trading rules will be modelled using n-person cooperative and non-cooperative games. Finally, Phase 3 will test the trading rules and procedures developed in Phase 2 using experimental simulations of trade between actual water traders.

Existing water trading participants

Prior to developing such rules and procedures a thorough evaluation of current trade in the focus sub-catchments is necessary. Phase 1 of the project will (a) conduct an overview evaluation of existing trading rules and procedures in the focus sub-catchments, considering economic efficiency, equity and procedural justice, (b) collect and analyse water market activity data and estimate supply and demand functions for water in focus sub-catchments and, (c) review community acceptance of trade in water entitlements and willingness to become involved as players in simulations of future water markets through community consultation and workshops.

Future trading

Phase 2 will, in conjunction with the industry Parties, develop scenarios as to the nature of water markets in 2010 and alternative sets of trading rules and procedures. Permutations of trading rules and procedures are likely to include alternative definitions of water entitlements and tradable rights (including the separation of rights to own water from the ownership of land, and the associated hydrological constraints of trade), announced allocations/levels of sales water and highflow releases, water tariffs, exchange rates, impacts on environmental flows, crop prices and weather, and transaction costs. Gaming models will be used to formulate multilateral bargaining models to simulate the efficient operation of such rules and procedures - the outcomes of this modelling are to be compared and evaluated against the experimental outcomes of Phase 3.

Experimental aspects

Phase 3 will involve three sets of experiments in each focus sub-catchments. The first set of experiments will involve traders operating under existing trading rules and procedures. This will provide the control for future reference. The second set of experiments will incorporate the trading rules and procedures evolving out of phases 1 and 2 and the hydrological exchange rates and operational efficiency requirements developed in Projects 3.1 and 3.3. The final set of experiments will allow the traders to form coalitions in order to simulate more mature water market activity under simulated hydrological and weather conditions modelled in Projects 3.1 and 5.1.

Trader participation

It is expected that each set of experiments will require 8-12 irrigators to spend some 2 to 3 days participating. The willingness of extractive users to participate will be central to the success of the project. To promote participation and real behaviour in the market Smith (1990) argues that the reward system has to be salient. In other words, the participants need to be rewarded for their activity in such a way that will ensure their strategies are realistic. To achieve this it is proposed that a sum of money be made available to reward traders for the performance in the markets.

Potential outcomes

The project is very exciting and will potentially contribute significantly to the future management of catchments and associated use of water in Australia. This project will provide a new dimension to strategic planning which is

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 TECHNICAL REPORT

BLACKBURN LAKE DISCHARGE AND WATER QUALITY MONITORING PROGRAM: DATA SUMMARY AND INTERPRETATION

by

Sharyn RossRakesh
Chris Gippel
Francis Chiew
Peter Breen

Report 99/13

The 100 page report documents work undertaken by the CRC for Catchment Hydrology and the CRC for Freshwater Ecology on the performance of an urban pollution control pond in Melbourne.

Copies of this report are available from the Centre Office for $25.

largely unexplored in Australia - to simulate such trade based on actual trader actions rather than producer and consumer behaviour theory. In essence, the project stimulates new knowledge and understanding of economic behavioural theory, as well as providing industry parties with a new tool in their strategic planning toolbox. Industry participants, potential traders and interest groups will all be actively involved in the project.

Following a thorough evaluation of existing markets in the focus sub-catchments and workshops with industry to develop 'best guesses' as to the structure and conduct of future water markets, potential traders will be given scenarios and asked to trade in hypothetical markets. The outcomes to trade will provide valuable information for evaluating existing optimisation models and provide important strategic information for industry parties, first in the focus sub-catchments and then as a technique for consideration by water authorities and government departments throughout Australia. It is invisaged that the potential gains will be significant and provide valuable insight into future policy evaluation techniques.

Brooke, A., D. Kendrick, et al. (1988). *GAMS: A Users Guide*. CA, TheScientific Press.
Smith, V. L. (1990). *Experimental Economics*. Aldershot, Hants, England, E. Elgar ; Brookfield Vt. USA: Gower Pub. Co.

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PROGRAM 4
URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Tony Wong

Program planning and scoping

1.CRC Workshop on Monitoring Urban Stormwater Quality

Planning for an extensive monitoring program of urban stormwater has commenced with research activities focussing in two areas, ie. the characterisation of urban stormwater pollutants (eg. metals, nutrients associated with organic and inorganic solids, PAH etc in any of the following forms: pollutant concentration (mg/g) Vs particle size distribution; suspended load (mg/l) Vs settling velocity distribution; and/or pollutant concentration (mg/l) Vs settling velocity distribution) and the assessment of the performance of stormwater quality improvement facilities (GPT, ponds, wetlands, infiltration systems etc.)

The first task in the project is to develop field-monitoring protocols and procedures. A stormwater quality monitoring workshop (scheduled for February 2000) will be convened to facilitate the development of field monitoring protocols, procedures and database format. Those interested in participating in this workshop should contact Tony Wong.

- Stormwater Pollutant Characterisation

For the characterisation of urban stormwater pollutants to aid the development of pollutant export relationships and pollutant speciation characteristics, stormwater quality constituents will be categorised according to their relative priorities (to be identified in the stormwater quality monitoring workshop). It is envisaged that the different categories of stormwater quality constituents and pollutant characteristics can be at three levels to allow appropriate (optimal) utilisation of the available monitoring budget. The lowest level (Level 1) defines the water quality constituents and pollutant characteristics which should be analysed for all samples collected at the monitoring sites. Water quality constituents and pollutant characteristics listed in the higher levels (Levels 2 & 3) will only be analysed for a smaller number of selected samples. Possible priorities of water quality constituents and pollutant characteristics are listed in Table 1. This is an illustration of the expected outcome from the stormwater quality monitoring workshop.

STORMWATER QUALITY INFORMATION CATEGORISATION

Water Quality Constituents	LEVEL1	LEVEL2	LEVEL3
Suspended Solids	• TSS • Particle Size Distribution (PSD)	• Settling Velocity Distribution (SVD)	
Nutrients	• TP • TN	• PO4 • NH4 • TOC	• Nitrate/Nitrite • Speciation of P according to PSD • Speciation of P according to SVD
Metals		• Cd • Cr • Cu • Ni • Pb • Zn	• Speciation of metals according to PSD
Others		• pH • TDS • BOD	• pesticides • herbicides • PAH

Table 1. Stormwater Quality Information Categorisation

- Performance of Stormwater Improvement Facilities

The performance evaluation of stormwater quality improvement facilities involves monitoring the hydraulic performance of the facilities and the water quality of the inflows and outflows of these systems. Depending on the operating characteristics of the facilities, it may be necessary to monitor flow characteristics and water quality at intermediate locations within these facilities. Information on the hydrologic/hydraulic operation of these facilities and the stormwater quality constituents to be monitored will need to be categorised according to their relative priorities (identified in the stormwater quality monitoring workshop). It is envisaged that the different categories of information can be placed at three levels, with the lowest level (Level 1) being the information on the hydrologic/hydraulic operation and water quality which should be collected for all facilities being evaluated to provide a minimum basis for their evaluation. Information listed in the higher levels (Levels 2 & 3) will only be collected for a smaller number of selected stormwater quality improvement facilities. Priorities for information levels are listed in Table 2. This is also an expected outcome from the stormwater quality monitoring workshop.

2. A CRC Scoping Project - Field Experiments on the Effectiveness of Constructed Wetlands in the Removal of Suspended Solids

This summer, we will be embarking on some field experiments as part of a scoping project to plan and trial field experimental techniques aimed at quantifying the effectiveness of vegetated wetland system in the removal of suspended solids in stormwater. Britta Dahnke, a final-year undergraduate student from the University of Essen, Germany will be undertaking this investigation as part of her final year thesis with assistance of a number of others in the CRC, including Tracey Walker (CRC Research Assistant), David Reginato and Michael Oke (both recently appointed CRC Vacation Studentships).

- Stormwater pollutants

Stormwater pollutants are transported in particulate and soluble forms. Many of these pollutants are sediment-bound contaminants, such as heavy metals, nutrients and polycyclic aromatic hydrocarbon. It is for this reason that the reduction of suspended solids in stormwater is considered a primary objective of stormwater treatment.

While the use of wetlands is becoming widespread in urban design, there is little quantitative performance data to provide guidance in the design of these facilities to meet specific water quality targets associated with sediment-bound contaminants.

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.

NEW TECHNICAL REPORT

PREDICTING THE EFFECT OF VEGETATION CHANGES ON CATCHMENT AVERAGE WATER BALANCE

by

Lu Zhang
Warwick Dawes
Glen Walker

Report 99/12

This project's aim was to estimate the effects of afforestation or deforestation on run-off that leads to recharge to some of the alluvial catchments in the upland areas of the Murray-Darling Basin. The method proved to be very successful and can be more widely used by providing a basis for making estimates of the water yield impacts of wide-scale afforestation in Murray-Darling Basin

Copies of this report are available from the Centre Office for $25.

- Vegetation aspects in solids removal

Treatment processes involve a combination of physical, chemical and biological mechanisms with the physical mechanism of enhanced sedimentation promoted by wetland vegetation being generally dominant. Factors influencing the effectiveness of enhanced sedimentation include a combination of sediment particle size, organic biofilm coating and the types of vegetation within the wetland. Past research studies, notably by Sara Lloyd as part of her MEngSc (Research) candidature, have provided qualitative evidence of significant entrapment of fine particulates on surfaces of wetland vegetation. The trapping of these particulates by sedimentation in non-vegetated detention systems (eg. ponds) would not have been possible owing to their very slow settling velocities. According to standard sedimentation practice, the removal efficient of suspended particles in sedimentation system may be expressed as follows:-

$$R = 1 - \left(1 + \frac{1}{n}\frac{v_S}{Q/A}\right)^{-n}$$

where R = fraction of initial solids removed

v_S = settling velocity of particles

Q/A = rate of applied flow divided by the surface area of the basin or wetland

n = turbulence or short-circuiting parameter (between 0 and 1).

It is envisaged that that the presence of vegetation will increase the fraction of soldis removal. It is possible to quantify the effect of this by defining a "vegetation" factor applied to either the dependent variable R above or to the particle settling velocity v_s.

INFORMATION CATEGORISATION FOR EVALUATION OF STORMWATER QUALITY IMPROVEMENT FACILITIES (EXAMPLE ONLY)

Stormwater Quality Improvement Facility	LEVEL1	LEVEL2	LEVEL3
Gross Pollutant Traps Infiltration Systems	• Inflow, outflow and by-pass discharges. • Continuous water levels within the trap. • Volume and weight of trapped gross pollutants and sediment. • Particle Size Distribution (PSD) of trapped sediment. • Construction cost. • Maintenance requirements and operating cost.	• Composition of gross pollutants trapped. • Nutrients and metals contained in trapped sediment. • Dry weather inflow/outflow TP, PO4, TN, TSS conc. & hydrocarbon). • Continuous DO, pH within trap.	• Dry weather inflow/outflow metals conc. • Wet weather inflow/outflow TP, TN, TSS & metals conc. • Wet weather inflow/outflow TSS particle size distribution and settling velocity distribution. • mosquitos
Infiltration Systems	• Inflow and outflow discharges. • Continuous water levels. • Wet weather inflow/outflow water quality TP, TN, TSS conc. • Wet weather inflow/outflow TSS particle size distribution and settling velocity distribution. • Construction cost. • Maintenance requirements and operating cost.	• Wet weather inflow/outflow PO4, Nitrite/Nitrate, metals and BOD conc.	

(Similar listings are available for Swale Systems and Constructed Wetlands)

Table 2. Information Categorisation for Evaluation of Stormwater Quality Improvement Facilities (Example only)

- Field experiments

Field experiments will be conducted at the Hallam Valley Wetland in Melbourne. These will trial experimental techniques for quantifying the significance of wetland vegetation in removing fine suspended solids in the waterbody. Experimental channels of approximately 3 m wide and 10 to 20 m length will be formed within the Hallam Valley wetland with the channels having different vegetation types and density, including a control channel which is predominantly open water with no vegetation. Experiments will involve the use of a pump to establish a controlled flow condition within these channels and the injection of graded sediment covering the clay-silt-sand range as tracer.

- Sampling and comparison of results

Samples will be taken at regular intervals along the length of the channels, and concentrations of suspended solids, the particle size distribution and settling velocity distribution characteristics will be determined to allow tracking of the change in these characteristics from the inlet to the outlet of the vegetated channels. These characteristics can then be compared against the control channel where the removal of suspended solids is principally by sedimentation.

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PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM MCMAHON

Project 5.2 – National Data Bank of Stochastic Climate and Streamflow Data

At its meeting on 19 November, 1999 the CRC for Catchment Hydrology Board gave approval for the two Climate Variability Projects 5.1 and 5.2 to commence core activity on 1 January, 2000. However, before that time, some fine tuning of the project and the relevant costings will be made. In the November *Catchword*, Francis Chiew described a little about Project 5.1 - Modelling and Forecasting Hydroclimate Variables in Space and Time. In this article, I'd like to outline the proposed Project 5.2 - National Data Bank of Stochastic Climate and Streamflow Data.

Uncertainty – a major gap

One of the major gaps identified by industry and researchers is the need to quantify the uncertainty in hydrologic systems as a result of climatic variability. This need applies whether the systems are complex water resources projects or simple planning models of catchment behaviour. For very simple systems analytical techniques for estimating uncertainty may suffice, but for the majority of the problems one has to resort to system simulation using stochastically generated data.

What is stochastic data?

Stochastic data are random numbers that are modified so that they have the same characteristics (in terms of mean, variance, etc and auto-correlation structure) as the data set on which they are based. For example, in 1954, Frank Barnes of the then Melbourne and Metropolitan Board of Works generated 1000 years of stochastic (or synthetic) annual streamflows for the Upper Yarra Dam investigation. He did this by assuming the annual flows were independent and normally distributed, and using a table of random numbers was able to generate the long time series. This was the first occasion in Australia in which stochastic data were used in hydrologic investigation.

Even though there are a number of stochastic models available in the literature, most of them have not been adequately tested with regard to characteristics at different time scales or at a number of locations with different climates. For instance, a proper daily model should

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

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.

preserve the monthly and annual characteristics in addition to preserving the daily characteristics. Moreover, estimation of the parameters for the models is not a trivial task.

Project goal

The overall goal of the project is to come up with a robust set of stochastic models for the generation of climate and streamflow data anywhere in Australia at different time scales and to provide parameter values with known levels of uncertainty for the developed models.

The first steps

Two early steps in the proposed methodology include a workshop and the development of a testing protocol. The proposed one-day workshop with stakeholders will be used to confirm the range of variables to be modelled during the (three-year) project.

Proposed variables

Following the Technical Advisory Group (TAG) meeting for the Climate Variability Program held in July 1999, we have developed a preliminary list of variables that would be modelled including the following:

- point site modelling
  - daily rainfall (monthly and annual)
  - daily areal potential evapotranspiration
  - daily point potential evapotranspiration
  - daily mean temperature (average of maximum and minimum)
  - daily global radiation
- catchment modelling (specifically for large catchments)
  - monthly rainfall
  - raindays per month
  - appropriate climate data

(For the Murrumbidgee catchment we anticipate having to produce stochastic data for the above monthly rainfall and other climatic variables for 26 sub-catchments so that the spatial correlation structure between the variables is preserved).

Testing protocol

Another aspect of the project that must be decided early in its life relates to adopting or developing a testing protocol that will allow us to assess the advantages and disadvantages of one model over another. We also need to be able to determine how a model performs in relation to the historical data that is used to develop the model parameters. In terms of daily rainfall modelling, we know that there are several models available. The protocol will allow us to establish which is the best model and whether or not it is adequate for stochastically generating the given variable.

As noted above, this is the first part of the detailed research methodology in Project 5.2. We will describe further details of the envisaged research in later issues of *Catchword.*

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PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Ian Rutherfurd

Program planning

It can be dull always reading about planned activities in newsletters. So in this special Christmas edition I will talk about some achievements, some hatches, despatches and some gossip. But first a brief comment on the planning for the River Restoration Program.

Planning

The program proposals for projects 6.1, 6.2 and 2.1 have gone to the CRC Board for review. The Board's main recommendation relates to timing of the projects. Start of the components of the projects that involve close cooperation with the Cooperative Research Centre for Freshwater Ecology are to be delayed until next July, 2000. This will allow us to synchronise our planning with Freshwater Ecology's.

Despatches

There have been a few key people move on from the river restoration stable in the last few weeks. Kathryn Jerie has worked diligently and tirelessly on the Stream Rehabilitation Manual for the last two years (that is after starting on a short term contract that was only expected to last 6 weeks!). Kathryn has moved to Tasmania where she is working for the Nature Conservation Branch of the Dept. of Primary Industry etc. (GPO Box 44A, Hobart 7001 kjerie@dpiwe.tas.gov.au). She is working on an NHT funded project identifying high quality streams that should be preserved – a task she is very well equipped to do! We wish her all the best, and I would like formally record my appreciation of Kath's efforts for the research centre.

Also leaving for Tasmania, by a remarkable coincidence, is John Gooderham. John is an aquatic ecologist who has done stirling work on the Campaspe environmental flow project. You will recall recent articles in *Catchword* where John described the habitat modelling work on the Campaspe. His ecological skills have been invaluable to our team and he will be sorely missed. At present he is writing up his work, and is attending a limnology conference in NZ with Rebecca Bartley. Rebecca is presenting some of her work on the recovery of streams from sand slugs.

A final dispatch … Bruce Abernethy has completed his PhD in the Riparian Zone project (managed by Ian Prosser, and supervised by me) looking at the role of trees in bank stabilisation. Over the past year Bruce has been working as a Post-doctoral Fellow in the Waterway Managment Program, with the last six months spent at the University of Melbourne. In this time he has written several good papers on trees and bank stability (contact me if you want references), as well as a report on predicting widths of riparian vegetation for bank stability (see advertisement for this in the margin of this *Catchword*). Sadly (for us) Bruce has now left us to begin work with SKM. It has been a pleasure working with Bruce, and I wish him all the best in his new career direction!

Other work underway

Here are some other activities over summer in the program. There will be lots of work in flumes and in the field over January and February. Lindsay White has finished one flume session on vertical slot fishways, Scott Wilkinson is contemplating building a flume to model pools and riffles, and Nick Marsh is starting work on the giant (35m long) flume at the University of Melbourne to test his numerical models of scour around large woody debris. At the same time, Scott and Rebecca Bartley will be doing some heavy field-work (with the assistance of vacation scholars) up to March.

Thanks

Finally, may I thank everybody for their great work in the River Restoration Program over 1999. It has been a productive and exciting year. And as you lie next to beautiful streams over the summer break, renew your commitment to rehabilitated streams, But also keep your eyes open for long, straight reaches with well developed pools and riffle sequences that Scott Wilkinson can survey for his thesis! Happy Christmas and a safe New Year!!

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TECHNICAL REPORT

GUIDELINES FOR STABILISING STREAMBANKS WITH RIPARIAN VEGETATION

by
Bruce Abernethy and Ian Rutherfurd

Report 99/10

The Queensland Department of Natural Resources contracted the CRC for Catchment Hydrology to write technical guidelines to help specify the width and composition of vegetated riparian zones, for bank erosion control.

This report will guide and focus the practitioner's approach to planning riverbank stability works using vegetation.

The report is available from the Centre Office for $25.

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

ANNUAL REPORT

The CRC for Catchment Hydrology 1998/99 Annual Report is available.

Free copies can be obtained from the Centre Office.

CRC REPORTS PUBLISHED DURING 1999

98/7 *Managing Urban Stormwater Using Constructed Wetlands (Second Edition)*
Tony Wong, Peter Breen, Nicholas Somes, Sara Lloyd

99/1 *The Hydrologic Impacts of Forestry on the Maroondah Catchments*
Fred Watson, Rob Vertessy, Tom McMahon, Bruce Rhodes, Ian Watson

99/2 *Removal of Suspended Solids and Associated Pollutants by a CDS Gross Pollutant Trap*
Tracey Walker, Robin Allison, Tony Wong, Rick Wooton

99/3 *Urban Stormwater Quality: A Statistical Overview*
Hugh Duncan

99/4 *Implications of Irrigation Bay Management for Salt Export: A Study of Irrigation Bay Processes in the Barr Creek Catchment*
Mat Gilfedder, Luke Connell, Russell Mein

99/5 *Irrigation Bay Salt Export and Salinity Management – Industry Report*
Mat Gilfedder, Luke Connell, Russell Mein

99/6 *Second Erosion in Forests Workshop – May 1999*
Jacky Croke, Patrick Lane

99/7 *Physical Evaluation of Rehabilitation Works on Broken River and Ryans Creek, North Eastern Victoria*
Michael Stewardson

99/8 *Effectiveness of Street Sweeping for Stormwater Pollution Control*
Tracey Walker and Tony Wong

99/9 *A Daily Rainfall Generating Model for Water Yield and Flood Studies*
Walter Boughton

99/10 *Guidelines for Stabilising Streambanks with Riparian Vegetation*
Bruce Abernethy, Ian Rutherfurd

99/11 *Managing Sediment Sources and Movement in Forests: The Forest Industry and Water Quality*
Jacky Croke, Peter Wallbrink, Peter Fogarty, Peter Hairsine, Simon Mockler, Bob McCormack, Jim Brophy

99/12 *Predicting the Effect of Vegetation Changes on Catchment Average Water Balance*
Lu Zhang, Warrick Dawes, Glen Walker

99/13 *Blackburn Lake Discharge and Water Quality Monitoring program: Data Summary and Preparation*
Sharyn RossRakesh, Chris Gippel, Francis Chiew, Peter Breen

CRC WORKING DOCUMENTS PUBLISHED DURING 1999

99/1 *Preparation of the CRC-Forge Design Rainfall Database for Victoria*
Lionel Siriwardena, Erwin Weinmann

CRC VIDEOS RELEASED DURING 1999

99/1 *Constructed Stormwater Wetlands: From Design to Construction*
Industry Seminar speakers: Tony Wong, Peter Breen, Alf Lester, Tony Brindley

99/2 *Predicting Water Balance of Pastures in Catchments – Irreconcilable Differences Between Data and Model: Which is the Culprit?*
Richard Silberstein

99/3 *Erosion in Forests Field Tour, Warburton, Victoria*
Featuring a range of research and industry speakers on site

99/4 *Catchment Water Balance: A Simple Approach*
Lu Zhang

CONFERENCE PROCEEDINGS PUBLISHED BY THE CRC DURING 1999

Second Australian Stream Management Conference Proceedings
Edited by Ian Rutherfurd, Rebecca Bartley - two volumes (750pp)

All these reports and videos are available from the Centre Office

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COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

Highlights from 1999

I have a wall calendar that I use for planning and recording activities relevant to the Communication and Adoption Program. Even at a glance, it is clear that 1999 has been an excellent year for the CRC – quite apart from the obvious benefits of being successful in receiving a second round of funding (1999- 2006). Each month, the CRC has had a workshop or given Industry and Technical seminars to land and water practitioners. We have also been committed to ongoing collaboration with the land and water management industry in drafting up the research programs and projects for the new CRC.

Highlights roundup

Highlights from this year for me include:

- the Second Australian Stream Management Conference in February
- the Stream Rehabilitation Seminars in Canberra, Sydney and Brisbane and the Salinity Disposal Basin Workshop (Project S2) in March
- the CRC Association Excellence in Technology Transfer Award being presented to Melbourne Water and the CRC in April
- the Erosion in Forests Workshop at Warburton, and the Constructed Stormwater Wetlands Industry Seminars at Canberra, Sydney and Brisbane in May
- the Irrigation Bay and Salinity Management Regional Seminars in Kerang, Tatura and Griffith and the 'Scaling Workshop' in June
- the Technical Advisory Group meetings involving research and industry representatives for each Program throughout July
- the first Board meeting of the new CRC in August
- the joint program leaders meeting between the CRC for Freshwater Ecology and our CRC in September – this meeting catalysed further links between the two CRC's research and communication programs
- the Constructed Stormwater Wetlands Industry Seminars in Adelaide and Perth, and the first meeting of the Programs Leaders and Focus Catchment Coordinators in October
- The Managing Sediment Sources and Movement in Forests Industry Seminars and Design Flood Estimation Workshop in November.

Other activities

This year the CRC has presented over twenty Technical Seminars in Hobart, Melbourne, Canberra and Brisbane as well as regional Victoria, New South Wales and Queensland. By the year's end, the CRC will have published another three industry reports including a second edition and 14 technical reports. All of these activities aim to catalyse collaboration between research and land and water management organisations and ensure practical implementation of our research results.

Thank you

The CRC's commitment to fostering this collaboration and knowledge exchange via the Communication and Adoption Program arises through the personal and professional commitment of the CRC researchers and staff within the CRC Parties. At the year's end, I would like to thank all those many people who through their research, support, professional networks and skills have contributed to a very successful year for this program.

In the New Year…

To ensure that the substantial amount of resources invested by the CRC in the Communication and Adoption Program is well spent, it is essential that all of our knowledge exchange (technology transfer) techniques are the most effective and efficient. The CRC's research activities have evolved from discipline based programs in the initial CRC to integrated, thematic programs in the new CRC. Accordingly, this gives rise to new challenges in planning, delivering and monitoring the most effective communication and adoption strategies and activities.

Over the next twelve months, particularly during the first part of next year, a planning process will be developed and put in place to deliver our research outcomes to end users according to best practice principles. This will involve re-examining and redefining the relationships with the end-users of our research and ensuring that they are an integral component of this program's planning and implementation. Our goal is to be among the best in the world.

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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.

CRC PROFILE

Our profile for December is John Tisdell

John Tisdell is Program Leader for the sustainable water allocation program of the CRC for Catchment Hydrology and lecturer in Environmental Economics at Griffith University.

John completed a Bachelor of Commerce majoring in Economics from the University of Wollongong in 1991. After graduating he worked as a casual tutor at the University of Wollongong and what is now the University of Western Sydney, teaching monetary and fiscal policy, and analysis of unemployment and inflationary trends in the Australian Economy.

In 1992 he accepted a lecturing position at Charles Sturt University, Wagga Wagga. During his time at Charles Sturt University he lectured mainly in microeconomics and managerial economics. While teaching accounting students in a mainstream business department, his research took him away from mainstream economics into agricultural decision making, and in particular into the application of Bayesian analysis to agricultural economics issues.

In the mid-eighties he accepted a position at Gatton Agricultural College teaching business statistics and economics - initially in the Department of Management Studies, and in the Department of Computer Science and Statistics. When the resident biometrician became Faculty Dean he found himself diversifying away from business statistics into biometrics. For some years every degree student at the college had to face a semester, and on occasion two semesters of his statistics subjects. He also consulted as a biometrician on agricultural research projects at the college and published in journals such as Postharvest Biology and Technology on a diverse range of projects, from tropical fruit harvest and storage optimisation to deer breeding.

Between 1991 and 1994, whilst working at Gatton college, he completed a PhD in Environmental Economics through the University of Queensland. The thesis explored the equity and social justice of Australian water law and water right regimes, water pricing, notions of environmental flow rights, as well as estimating water trading solutions using optimisation models constrained by equity and efficiency conditions. The PhD was awarded the prestigious Australian Agricultural and Resource Economics Society PhD prize for the most outstanding PhD in Australia and New Zealand for 1993 and 1994. Papers arising from the thesis appear in journals such as Water Resources Research and Economic Analysis and Policy.

In 1995 he took his current position as Lecturer in Environmental Economics at Griffith University. The position opened a wide range of research topics and interests. His research has explored issues including the economics of climate change, biodiversity and green national accounting. As a result of this research he has been an invited speaker at a number of national and international conferences, including the National Climate Change conference in 1997 and the International Conference on Environment and Agriculture in Nepal in 1998. During his visit to Nepal he was also invited to a private session with the King and Queen of Nepal to discuss Nepal's environmental problems. Until recently he was the vice-president of the Australian and New Zealand Ecological Economics society.

Taking on the role of program leader of the sustainable water allocation program has brought him back to some extent to his core doctoral training. He now faces the challenge of getting the new program operational and researching the water allocation issues of the next millennium.

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WHERE ARE THEY NOW?

Report by Ben Dyer

The short answer is the Murray-Darling Basin Commission Water Policy Group. How I ended up here is a somewhat longer story. Basically since finishing my PhD I abandoned academia (I am no good at writing papers) and wandered off into the area of river management and operations.

Straight after I completed my PhD I had a six month contract to develop some hydraulic design guidelines for retards (log fences extending into streams used for bank protection/stabilisation). This was a successful project and delivered information that would allow designers to consider the characteristics of their stream and adjust the design of their retards to maximise sediment trapping. A key finding from field observation was that retards enabled vegetation to become established. The vegetation appeared to be the primary means of stabilising sediment trapped by the retard (and once established trapping more sediment) and protecting the bank.

After this it was a move to Canberra and a position with the MDBC and a range of jobs. The most interesting of these was 'running the river'. This involves reviewing the orders for water from the River Murray, considering current and expected weather conditions, travel times in the river (28 days to the first re-regulation storage) and then scheduling the releases from the various storages. This proved to be the most interesting and challenging job I have had – everyday I saw how good my past decisions had been and I could work out what I could have done better. I also saw opportunities for environmental benefit by adjusting operations within the system constraints (eg requirement to supply irrigation water). This resulted in my paper "Love Your River – Love Your River Operator" at the 2nd Australian Stream Management Conference.

The responsibility of river operation becomes apparent very fast. It is easy to let out extra water and not be worried that someone may be short of water – but that extra water is wasted. It is of no value to an environment that is adapted to summer droughts, and it spills from the system so is lost for irrigation. Thus the cost of an easier life for the river operator is about 200 megalitres or $20 000 per day – a fact that I think is often overlooked.

After 18 months running the river I was transferred to the Water Policy Section where I ended up working on the EIS for Lake Victoria (a natural lake that was modified to become a water storage in 1929 – the first major storage on the Murray). Aborigines had been living at the Lake long before regulation and had buried their dead in the barrier islands and lunette. With regulation these islands had eroded exposing some of the burials. The lake is an essential storage in the River Murray system – affecting access to water for everyone along the River Murray and remains highly significant to the Barkindji people. The EIS sought to develop a balance between these competing interests. One outcome of the project has been a comprehensive cultural heritage assessment and protection of the burials – the largest such project undertaken in Australia.

In 1998 I was awarded a Churchill Fellowship and earlier this year travelled to the USA, Canada and South Africa. I was looking at the institutional and operational aspects of management of major river systems. The key observation was that the cooperative approach to water management that Australian Governments have adopted is unique. In this area, our approach is truly world's best practise. In the technology field and the application of modelling tools for managing our rivers we are not so competitive. This appears to be largely due to a lack of funding and strategic planning is an area where Australia needs to make a major investment in implementing some high quality packages.

Currently I am supervising the calibration of a salinity model for the Edward-Wakool River system as part of the review of salinity management in the River Murray (an exercise in frustration with random and non-concurrent data sets). My main task for the next six months is to develop a new model for use in predicting, for a range of inflow conditions, the volume of water available for consumptive use in the coming year and how the various storages will need to be operated to deliver that water.

My involvement with the CRC continues, representing the Commission on the steering committee for Project 5.2 – National data bank of stochastic climate and streamflow models.

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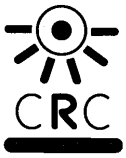
COOPERATIVE RESEARCH CENTRE FOR **CATCHMENT HYDROLOGY**



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

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