NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 100 NOVEMBER 2001

A NOTE FROM THE DIRECTOR

Professor Russell Mein

Inside...

COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD MAKES A CENTURY!

This is the 100th issue of *Catchword*, the monthly newsletter of the CRC for Catchment Hydrology. A milestone by any standards, more for the continuity it represents than for being a target achieved.

Catchword began in November 1992, four months after the commencement of the initial CRC. With the newness of the CRC concept, bringing users and researchers together from eight different organisations, a newsletter was seen to be important for internal communication. This was in the early days of email, and several Parties were 'not connected'.

John Molloy, our Business Manager, suggested the name, and no-one could think of one better - so *Catchword* it was. Our Board Chair John Langford was enthusiastic, urging us to stick to a monthly schedule, 'even if an issue is a couple of pages'. Program Leaders, who tended to write all the articles in the first year, were not always as convinced; there were some requests that we consider reducing the frequency, to perhaps quarterly, early in my term as Director. These fell away when it was realised just how powerful a communication vehicle we had created.

The structure of the newsletter was soon established, and has remained pretty 'standard'. A Director's report, followed by a Program Round-up, Postgraduate and Staff Member profiles, and (later) 'Where Are They Now?' The format, however, became more professional after David Perry joined us; his surveys of readers showed that they felt we could improve our newsletter further with a new layout.

The *Catchword* subscription list grew rapidly, as requests from people outside the CRC Parties began to arrive. We now send out 1200 copies (30% by email) to subscribers, with another 150 distributed to Parties of the CRC. We keep the list current by asking people every so often if they want to stay on it. In this process, they have to return a form to us; so a 'yes' answer is required. Nowadays, subscriptions can be lodged on the CRC web-site, yet another feature of the electronic age that is proving popular. [See also David's article on web-site searching later in this edition].

Usefulness of Catchword

Subscription lists are one thing, but they don't indicate how effective our newsletter is as a communications vehicle. Early this year, we had Econnect Communication Pty Ltd conduct a review of all of our communication activities by surveying a range of target stakeholders. Perhaps unsurprisingly, *Catchword* came out top of the list, ranked highly across all stakeholder sectors. Some 90% of people ranked it above average on a scale of effectiveness.

Who reads what? I spoke recently to the head of a research-funding organisation who said he turned first to the postgraduate student profiles; he liked to read about the skilled young people coming through. Our surveys, however, show that the Director's Report is most read (phew!), followed closely by program and project information. I am often surprised (and pleased) at the number of people I've met who say they read *Catchword*.

The next 100?

We'll continue to rank the production of *Catchword* high on our list of priorities for communication; given its effectiveness as an awareness-raising vehicle, we could hardly do otherwise. I expect that the proportion of readers opting for the electronic version will increase with time - you get it earlier that way too! More integration with the web-site will be likely to develop. Whatever the delivery medium, the copy still has to be written.

We're on our way to another 100!

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CRC PUBLICATIONS LIST

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

www.catchment.crc.org.au

All prices listed include GST, postage and handling.

The Centre's products can be ordered through the Centre Office.

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PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Rodger Grayson

Terrain and the distribution of soil moisture

Background

The following is an edited version of an invited commentary that recently appeared in Hydrological Processes (Grayson and Western, 2001).

As we increasingly make use of digital terrain analysis and hydrological models based on digital elevation data, the need for good old fashioned hydrological reasoning loses none of its importance if we are to avoid mis-interpretations.

Insights from patterns

Humans tend to be fascinated by patterns, from the richness of materials woven by ancient cultures to the awe with which we view the unfolding landscapes from the window of an aeroplane. As hydrologists, our work is all about deciphering patterns in space and time and dreaming up ways to capture their key elements - an approach to give us insight into processes or an improved ability to predict something about the water (and increasingly also the energy) balance.

Hydrological patterns and topography

A control on patterns of hydrological response that has received much attention over the last few decades is topography. Colourful digital elevation models, often with an index of relative wetness (eg. Beven and Kirkby, 1979; O'Loughlin, 1986) draped over a wireframe image, with a caption reading something like "distribution of soil wetness" are commonplace. Those patterns of soil wetness distribution that can be so easily generated with today's computer tools seem to be running the risk of leaping from the realms of speculation to being considered the truth. Is the ubiquity of wetness index images confirmation of the dominance of topography, or rather an example of "doing it because we can"?

Terrain or topographic impacts

Certainly there are times and places where topography can be a dominant control on depth to water table, soil moisture of the root zone, or the location of runoff producing areas. For terrain to affect moisture patterns, there must be lateral flow. This implies that:

- precipitation must exceed evapotranspiration for a long enough period to enable the build up of soil water to almost saturated conditions, and then for water to travel from hillslopes to gullies.
- some restrictive layer must exist over which lateral flow occurs, and if the lateral flow is to affect root zone soil moisture (rather than just supply water to the riparian area via a deeper groundwater system) it needs to be relatively close to the rooting depth of the vegetation.
- the effect of other factors influencing soil moisture distributions, such as variability in soil properties, vegetation, and meteorological forcing (including the effects of aspect) needs to be relatively minor.

We argue that in practice, this combination of features occurs less often than is commonly believed.

Runoff producing areas

What is indisputable is that in humid climates the gullies are places that get wet, for a variety of reasons. In addition, these areas are well identified by the various indices of wetness that have been proposed. Runoff models based on these indices (such as TOPMODEL) are able to represent the size (if not the exact location) of runoff producing areas. This is done by a combination of (i) having the correct basic form to represent the "wet end" of the distribution (in fact distributions differ surprisingly little between catchments- see eg. Franchini et al. 1996, Woods and Sivapalan, 1997) and (ii) having some level of calibration. It is also the case that models with other distribution functions can be successfully calibrated to represent runoff.

So for runoff prediction these distributions are effective, but is this the case when they are used to estimate the spatial variability of hillslope soil moisture? Nearly all tests of terrain indices have shown that they explain less than half the point-scale spatial variation in soil wetness, even under "ideal" conditions. Where comparisons between the shapes of the frequency distributions of soil wetness and terrain indices have been made, the correlation has been poor (Western et al., 2001).

Limitations of topographic control

We have now collected or collated spatial data sets of soil moisture from many sites in landscapes from semi-arid to humid environments. The more we collect and analyse, the more we realise that classic topographic control on patterns of soil moisture in the root zone is restricted to quite particular times and places. Even in humid climates (or wet times of year in sub-humid climates), when the gullies are wet and producing runoff, there is limited spatial organisation of root zone soil moisture on hillslopes.

Gullies and hillslopes – separate regions

The data we have seen indicate that it might be more realistic to consider a landscape as two separate regions. Firstly, gully areas that collect and convey water and where soil moisture is affected as a consequence, and secondly those areas on the "hillslope" where there is limited topographic influence, even during wet times, and if such influence exists, it is more likely to be due to aspect (solar radiation exposure) or variability of soil properties than to lateral flow processes.

The notion of considering the hillslopes separately from the gullies frees the modeller to consider what level of connectivity really exists between hillslopes and gullies. Depending on the landscape, this may be non-existent because vertical fluxes dominate over lateral; limited to some recharging of a deeper groundwater system that affects the wetness of the gullies but has negligible effect on the wetness of the hillslope root zone; or may be characterised by shallow subsurface flow paths so often assumed in terrain analyses. The first is likely in drier climates and at drier times of year in wet climates, while the second may be encouraged by well structured soils or macropores tending to "by-pass" the root zone.

Need for real patterns

Terrain-based simulations of soil moisture patterns are used not only in runoff modelling but also as surrogates to help with the interpolation of sparsely spread soil moisture measurements, as a method for disaggregating lumped estimates of catchment wetness, and to drive models of moisture dependent processes such as soil nutrient cycling. We should be using them because we have confidence that they represent real patterns, not just because we can produce patterns

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PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Ian Prosser

Modelling water quality and sediment transport

Sediment and nutrient sources

Researchers within the CRC for Catchment Hydrology and their colleagues have made considerable advances in understanding the sources and transport mechanisms of sediment and nutrients in catchments. In many parts of Australia, for example, riverbank and gully erosion deliver more sediment and more phosphorus to streams than agricultural soil erosion (see CRC Project 2.1 and its precedents). Much nutrient is transported with sediment but there are additional point sources and dissolved nutrients are found in surface and groundwater runoff (see CRC Project 2.5). These varied sources have been stated so often in *Catchword* articles, seminars and CRC reports that it seems tiresome to repeat them here.

River sediment loads

River sediment loads are far less than the sum of nutrient and sediment loadings – indicating substantial deposition or loss enroute through a river network. These stores too have been examined by CRC researchers: on hillslopes, in riparian lands, on floodplains and as sand slugs in streams (made famous by Rebecca Bartley and Ian Rutherfurd). Add reservoirs and in-stream denitrification and we have all the major components of a catchment sediment and nutrient budget.

Sediment and nutrient budgets

A budget is an account of the fluxes of material in a catchment, integrating the sources, stores and losses, and exports. A budget approach has the advantage that all the terms must balance. Sources must be balanced by losses and exports. This provides some powerful testing of terms in the budget. Mapping of agricultural erosion in a catchment must match observed values for that process. It must also be correct in relation to the magnitude of sub-soil erosion (tested by radionuclides), and with the other sources, produce the correct catchment exports without filling up reservoirs and burying floodplains along the way. Once all those criteria are met, there is not much freedom for major errors to go undetected.

Limitations of current models

These advances in understanding of sediment and nutrient transport at large scales remain to be included in

NEW TECHNICAL REPORT

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

by
Andrew Bradford
Lu Zhang and
Peter Hairsine

Report 01/8

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

Copies available through the Centre Office for $27.50.

UPDATED EVAPOTRANSPIRATION AND RAINFALL MAPS FOR AUSTRALIA

Where to get them!

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

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

They can be purchased from:

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

OR

2. **Bureau Regional Offices (all capital cities) Contact details for each Regional Office are available at**

   http://www.bom.gov.au/inside/contacts.shtml

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

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

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

the vast majority of catchment-scale sediment and water quality models. Such models are often based upon single factors, or a small sub-set of factors. Discharge is commonly used as the sole factor through rating curves, and associated technologies. Catchment area is favoured by geomorphologists, with Des Walling and Bob Wasson, for example, presenting continental synthesis of sediment yield vs area regressions. Other models are based on loadings as a function of land use. CMSS and published work on EMSS are good examples of such models. These models are constrained in their applicability by limited geographical extent or environmental conditions considered. Single factor models typically have large residual errors for many catchments. These errors represent all the other factors that contribute to water quality or sediment load. Cropping may be benign as a sediment source in some settings, but the same practice can result in massive soil loss in other settings.

Improved modelling approaches with sediment budgets

There is a strong policy need for improved catchment models. The National Salinity and Water Quality Action Plan has significantly raised the expectation on the level of understanding that is used to assess catchment restoration. This policy and others, such as the policy to protect the Great Barrier Reef from catchment exports, call for target setting and evaluation. This might include assessment of current water quality levels at some downstream asset, an examination of how restoration in the catchment upstream might improve water quality downstream, and an evaluation of whether the restoration works have met the water quality targets. This is obviously difficult, but this approach is being considered where possible. Other approaches are also possible. There is sparse monitoring of water quality in Australia, and the timescales for decision making are too short to establish monitoring programs now. Thus to achieve the above goal will require models that express the links between sources and downstream effects, through intervening deposition and losses, and which recognise the spatial variability of large catchments. A sediment and nutrient budget approach offers these features. Budgets conceptualise and integrate our current understanding of the driving processes, but they also require some careful thought about rapid and cost-effective approaches to monitoring and evaluation. These are required for independent testing of our conceptualisations, exposing errors, and guiding scientists to improve their understanding.

Recent work with sediment and nutrient budgets

CSIRO Land and Water have moved toward the goal of a spatially distributed sediment and nutrient budget model through their work for the National Land and Water Resources Audit. Sediment and nutrient budgets have been produced for all river basins from Cape York to the Eyre Peninsula and for SW Western Australia. These are at a coarse scale using nationally available data, but they do raise some interesting patterns (to be released later this year). Better results for particular catchments can be gained by adding regional data to the NLWRA approach. The NLWRA results of mean annual load can be distributed across flow records to give daily loads. CRC Project 2.1 is undertaking these tasks for some catchments.

Catchment examples

Modelling of Moreton Bay sediments has been completed and tested against observed sediment yields and radionuclide analyses as part of the South East Queensland Regional Water Quality Monitoring Strategy.

Work is well in progress for the Murrumbidgee R. and we are keen to incorporate the results into regional target setting there.

The NLWRA river model (SedNet) and NLWRA project outputs were used in a workshop on sediment transport in the Fitzroy catchment. We have the potential to go further with the Fitzroy assessment if the regional catchment agencies are supportive, and using better regional information, such as IQQM flow modelling and testing management scenarios. An advantage of the approach that we have taken is that it has separate modules for each of the budget components.

Thus to date we have used the USLE to map surface wash and rill erosion and use the resultant grid as an input to the SedNet river model. We can just easily use a different soil erosion model such as PERFECT and input that grid into SedNet. The main advance has been integrating the components in a manner that incorporates the understanding gained by CRC for Catchment Hydrology researchers and their colleagues.

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PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader

JOHN TISDELL

Report by Sergei Schreider

Project 3.1 "Integration of water balance, climatic and economic models": why and what to integrate?

Why is integration of models necessary?

An efficient and sustainable allocation of water resources must take account of climatic, hydrological and economic factors – factors currently analysed using separate models. Given the strong interactions between these factors, an integrated approach to modelling is needed. The integrated modelling system will be aimed at supporting the decision making processes of water authorities in Australia in the context of the COAG water reform framework. This reform framework implies among other initiatives, the introduction of free-market based water trading as a major tool for increasing efficiency of water use for irrigation.

Project task and framework

The major task of the CRC Project 3.1 is to provide relevant water authorities with enhanced tools to ensure efficient and sustainable water management. These tools are based on a modelling framework that:

- allows the application of new research results on climate change and land use impacts within a systematic water resource assessment;
- incorporates the factors that drive seasonal allocation decisions, including new regulatory constraints and medium-term forecasts of climatic conditions;
- simulates irrigators' behaviour affecting water demand, allowing for emerging factors such as water trading and technological change;
- assesses dynamic system behaviour in response to industry adjustments to the changing external environment;
- enhances the use of existing models as decision making tools by facilitating the development of decision making scenarios;
- makes the model results more relevant to stakeholders by translating the direct modelling results into more meaningful socio-economic and environmental performance measures.

IQQM and REALM

A particular characteristic of water resource assessment and management in Australia is the different approaches in hydrological modelling, including water quantity, quality, demand and allocation models, adopted by different Australian water authorities. New South Wales, Queensland and ACT use the IQQM (Integrated Quantity - Quality Model) based approach in water allocation management. Victoria, South Australia and Western Australia basically use REALM (REsource ALlocation Model). This situation requires a dual modelling option for the integration framework being developed.

What models are to be integrated?

The Project's target is to select appropriate modelling tools for each step of the modelling process and, ideally, to include the locally preferred models into the integrated system framework. The major task of the integrated catchment modelling system is to assess and evaluate different catchment management policies /scenarios by comparison of quantitative output characteristics (evaluation functions and indicators) corresponding to these policies /scenarios.

Climatic models

We have identified which climatic models will be incorporated in the integrated system under development. The climatic time series representing the future climate scenarios will be outputs from one of two CSIRO climate models. These are the Global Circulation Models CSIRO9 with spatial resolution of 600 km, and the Division of Atmospheric Research Limited Area Model - DARLAM with a resolution of 60 km. This work will be implemented in another CRC for Catchment Hydrology project: "Modelling and forecasting hydroclimate variables in space and time" (Project 5.1). The expected output is a 1000 year daily series of rainfall and temperature downscaled for meteorological stations in the Project's focus catchments for present and future climate conditions. These conditions will be simulated using CSIRO9 and DARLAM climate models.

Water resources modelling

A water resource system simulation model will be developed to combine water quantity, quality, demand and allocation modules. In selecting hydrological models we have to co-ordinate our work with the requirements and modelling standards accepted by water authorities who are the Project's primary stakeholders. In water allocation modelling, we meet the problem of the dual approach in Australian water resource management mentioned above: IQQM versus REALM. The major conceptual difference between IQQM and REALM is that IQQM itself is an integrated package including streamflow, demand, routing and allocation modelling tools. REALM deals specifically with water allocation modelling, whereas streamflow and water demand data must be generated externally.

WATER FORUM CRC SEMINAR SERIES - MELBOURNE

ASSESSING HEALTH RISKS FROM DRINKING WATER

Dr Martha Sinclair
Monash University
CRC for Water Quality and Treatment

Thursday
29 November 2001
5.00pm for 5.15pm

Main Auditorium
Victorian Branch Institution of Engineers
21 Bedford Street
North Melbourne, Victoria

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

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

For further information contact David Perry on 03 9905 9600

NEW TECHNICAL REPORT

IRRIGATOR AND COMMUNITY ATTITUDES TO WATER ALLOCATION AND TRADING IN THE MURRUMBIDGEE CATCHMENT

by

John Tisdell
John Ward
Tony Grudzinski

Report 01/1

This report presents the results of a Land and Water Corporation funded research project aimed at developing an understanding of irrigator and community attitudes to water allocation and trading. This document reports the findings of a survey of irrigators and community members in the Murrumbidgee catchment. The questionnaire elicited attitudes of irrigators and community members to the Council of Australian Governments (COAG) reforms, to temporary and permanent water trading, to the impact and future of water trading, to the role of the water authority in regulating the market and to environmental issues.

Copies available through the Centre Office for $27.50.

Routing can be modelled indirectly within REALM. Both IQQM and REALM include some tools for water quality modelling, which are currently being updated.

Streamflow aspects and water demand modelling

The IQQM model uses the Sacramento rainfall-runoff model for simulating catchment headwaters' streamflow. It is a conceptual lumped parameter rainfall-runoff model. In future the Sacramento model will be replaced with the more advanced hydrological model CATSALT which models irrigation salinity as well as the streamflow and land use impacts. Selection of a streamflow generating model hasn't been finalised at the present stage of project development. One of the CRC Catchment Hydrology products could be used, for example the streamflow model developed within Project 2.3 or the stochastically generated streamflow series from Project 5.1. Water demand models exist for both (IQQM and REALM based) water allocation modelling approaches. IQQM includes CROP MODEL 2 as a part of its integrated structure whereas REALM employs the external demand model PRIDE developed by the Rural Water Corporation of Victoria. Water allocation modules exist in both the IQQM and REALM systems.

Socio-economic modelling

The decision making and socio-economic modelling tools will be developed for transforming the direct water resource system simulation model outputs into more meaningful indicators of system performance. These outputs are usually expressed in terms such as: volumes supplied to different demand groups, frequencies of different levels of restrictions etc. Indicators may relate to economic, social and environmental benefits and costs to different stakeholder communities, and form the basis for performance evaluation.

Model sensitivity analysis

The sensitivity analysis of the IQQM model is now underway. This analysis is a very significant part of Project 3.1. The IQQM system is the most complex and sophisticated component within the modelling integration scheme. Therefore, the investigation of modelling efficiency, model sensitivity and modelling errors is especially important in relation to the IQQM package. The analysis of the IQQM sensitivity includes the sensitivity analysis of all modelling elements constituting this system. The sensitivity analysis of IQQM uses data for the Murrumbidgee catchment with the model calibrated for 1999/2000 conditions.

Structure of IQQM

The IQQM is a hydrological model simulating daily time series for a set of variables associated with the selected sites (nodes) in the catchment. Nodes represent structurally significant objects and links on the major river, its tributaries and irrigation canals. Nodes are classified into 12 major classes; some of these classes are divided into eight sub-classes. The IQQM calibrated for the Murrumbidgee catchment has 361 nodes of different types; each of those is associated with one to eleven modelled output variables. This detailed modelling system must be examined to see how sensitive it is to the variations of input data and model parameters.

The results of this sensitivity analysis combined with the analysis of calibration errors provide the range of the possible errors for IQQM simulation for different types of scenarios considered within the Project's framework. The IQQM sensitivity analysis, combined with the sensitivity analysis of other constituent models will allow project researchers to estimate the range of possible errors of the integrated system modelling under development.

Land and water industry involvement

Project work is progressing in collaboration with modelling specialists from the NSW Department of Land and Water Conservation.

Similar work on the sensitivity analysis of the REALM system calibrated for the Goulburn-Broken catchment is next in line. This work will be implemented with the active cooperation of Goulburn-Murray Water and the Department of Natural Resources and Environment, Vic.

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PROGRAM 4

URBAN STORMWATER QUALITY

Program Leader

TONY WONG

Report by Hugh Duncan

Hallam Revisited: Hydraulic Efficiency in Vegetated and Open Channels

Background

The field experiments carried out at the Hallam Valley stormwater treatment wetland in Melbourne have featured in *Catchword* on two previous occasions. In March 2000, Tracey Walker and Britta Dahnke reviewed the physical establishment of the paired open water and vegetated channels, and described the sampling runs being carried out at that time. Then in December 2000, Peter Breen and Tony Wong summarised the initial analysis of the experimental data obtained. In particular, they showed that contaminant concentration behaviour along the channels could be described by a first order kinetic (or k-C*) model. The present article starts with a review of the experimental layout, then describes some more recent analysis of the Hallam data.

Experimental layout

The field site was set up in the summer of 1999/2000. Two parallel channels were established in the wetland, each approximately 3 m wide, 20 m long, and 250 mm deep. One channel was densely vegetated with *Eleocharis acuta* (slender spikerush), while the other was open water with all vegetation removed. The channels were separated from each other, and from the remainder of the wetland, by 300 mm diameter plastic tubes filled with water. The bed of the open water channel was lined with plastic sheeting. The vegetated channel was not lined. The site is shown in *Figure 4.1*.

Site Layout

Water entered the upstream end of each channel through a levelled inlet box which distributed the flow evenly across the width of the channel. The inlet boxes were supplied from a constant head tank, which was in turn supplied with water from the wetland upstream of the site by a portable pump. A dye tracer was added to the inlet boxes under steady flow conditions on a number of occasions to check for leaks from the channels.

The two channels were each sampled for two replicates, two flow rates, and two input particle size distributions, making sixteen sampling runs altogether. Each sampling run was carried out by establishing steady flow conditions, dosing with a known mass of sediment at the inlet box, and sampling periodically at six locations along the channels.

Samples were taken manually, using a sampling rod fitted with an intake tube connected to an automatic sampler. The intake tube was moved by hand across the width of the channel while the sample was being withdrawn. Several samples were taken at each location, at time intervals intended to capture the pollutograph as it passed.

Hydraulic Efficiency

The treatment effectiveness of a pond or wetland depends on the nature of the flow passing through it. A layout in which the full storage volume plays an active part is more effective than one with unutilised areas of dead water, because no inflow water is short-circuited to the outlet along a preferred flow path. Also, behaviour

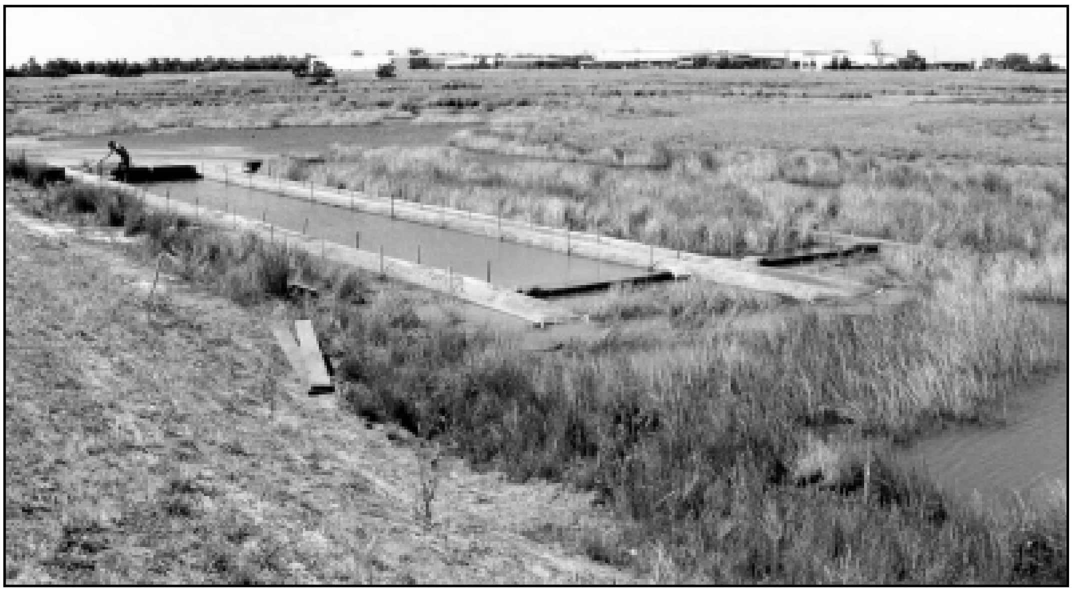

Figure 4.1. Site layout

NEW TECHNICAL REPORT

WATER SENSITIVE URBAN DESIGN IN THE AUSTRALIAN CONTEXT - CONFERENCE SYNTHESIS

by

Sara Lloyd

Report 01/7

In August 2000 a conference was held in Melbourne to highlight and explore the opportunities and impediments to the adoption of Water Sensitive Urban Design (WSUD). WSUD is the term used to describe a new approach to urban planning and design that offers sustainable solutions for the integration of land development and the natural water cycle.

This report collates and summarises the key issues raised at the conference, focusing on the current barriers to the widespread adoption of WSUD principles and offers possible solutions to help overcome both short term and long term issues.

Please note that conference attendees will be sent a complimentary copy

Copies available through the Centre Office for $27.50.

For further information contact the Centre Office on 03 9905 2704

WATER FORUM CRC SEMINAR SERIES - BRISBANE

THE WATER EROSION PREDICTION PROJECT (WEPP) DEVELOPMENT, APPLICATION AND STATUS

Dr Dennis Flanagan
USDA-Agricultural Research Service
National Soil Erosion Research Laboratory
West Lafayette
Indiana, USA

Wednesday
5th December 2001
10.30 for 11.00am start

Griffith University EcoCentre
Griffith University
Nathan Qld 4111

This free public seminar will provide information on the development of the WEPP model over the past 15 years, information on the the model scientific components, types and examples of model applications and current status of WEPP activities.

There is a $5.00 university parking fee. Parking is available in Bay F beside the Eco Centre.

RSVP for catering purposes to Mary-Lou Clarke, 07 3875 5394 or m.clarke@mailbox.gu.edu.au by Monday, 3 December.

The CRC WATER FORUM SEMINAR SERIES is a collaboration between the five water related Cooperative Research Centres (CRCs) to establish a regular series in Melbourne, Canberra, Sydney and Brisbane.

approaching plug flow conditions is more effective than behaviour approaching well-mixed conditions, because no inflow water is short circuited to the outlet by mixing in the storage. Areas of dead water and well-mixed flow both lead to an earlier outflow concentration peak, either by speeding up the entire flow (dead water) or by skewing the pollutograph (well-mixed flow). Hence the travel time of peak concentration through a storage is a good measure of desirable flow patterns.

Persson et al. (1999) defined the hydraulic efficiency (λ) of a treatment facility as:

$$\lambda = t_p/t_n$$

where t_p is the actual travel time of the peak concentration through the facility, and t_n is the nominal detention time calculated from the storage volume and flow rate. The upper limit of one indicates plug flow over the full storage volume, giving very effective treatment. The lower limit of zero indicates a completely well-mixed pond, or minimal engaged volume, or both, giving very poor treatment.

The Hallam results

The peak concentration travel times observed at Hallam can be used to calculate the hydraulic efficiency of the channels. Pollutographs of suspended solids concentrations passing each sampling point during one run are shown in *Figure 4.2*. The peak concentration and the area under the pollutograph (which represents load) both decrease rapidly with distance along the channel as material is lost from the flow, but for this analysis it is the timing of the peaks which is important.

Sample Pollutographs from One Measuring Run

The hydraulic efficiency (λ) has been calculated for four principal flow conditions – vegetated/high flow, vegetated/low flow, open/high flow, and open/low flow. The two periods of measurement and the two particle size distributions are treated as four replicates of each principal flow condition.

The results are shown in *Figure 4.3*, together with eyefit curves of mean vegetated and mean open channel behaviour. The vegetated channel exhibits consistently better hydraulic efficiency than the open channel. The hydraulic efficiency of the vegetated channel tends to increase as the length increases, from about 0.5 at 4 metres (length to width ratio of 1.3) to about 0.9 at 20 metres (length to width ratio of 6.7). Hydraulic efficiency of 0.9 is close to ideal behaviour, and indicates that a flow pattern approaching plug flow over the full channel volume has been achieved in the full length vegetated channel.

Hydraulic Efficiency of Vegetated and Open Channels

The open water channel typically achieves a hydraulic efficiency of about 0.5, and the length to width ratio has only a small effect. In this case, optimum flow conditions have not been achieved. This is a significant result, because in most respects other than vegetation the open channel follows accepted good practice – high length to width ratio, distributed inflow, and no hydraulically preferred flow path such as an old river channel. The presence or absence of vegetation appears to be a critical factor.

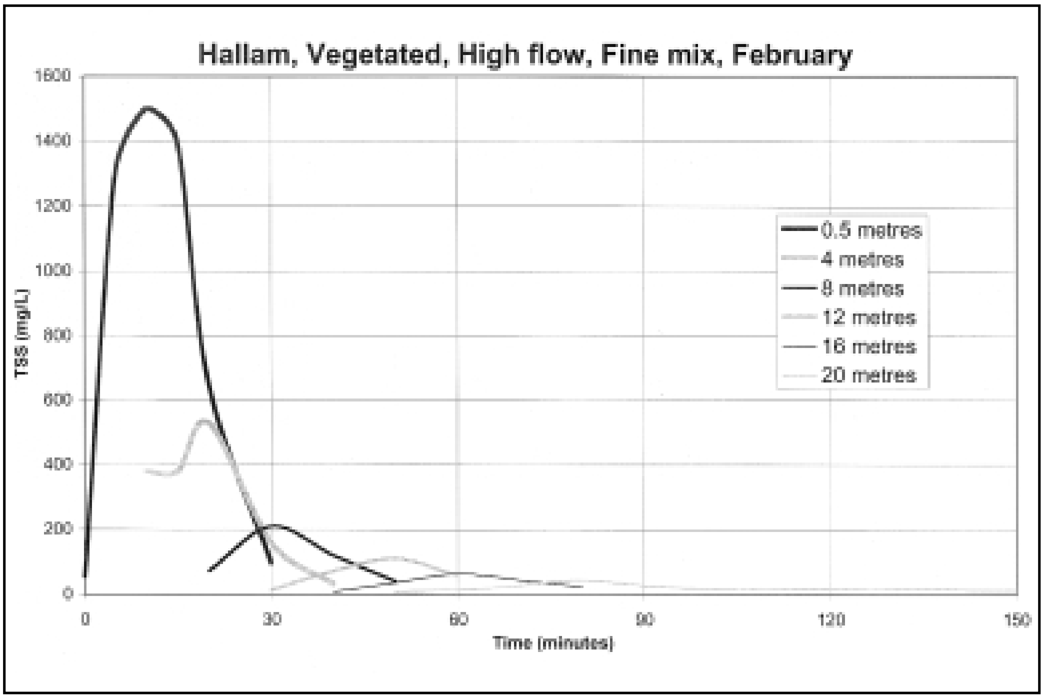

Figure 2. Sample pollutographs from one measuring run

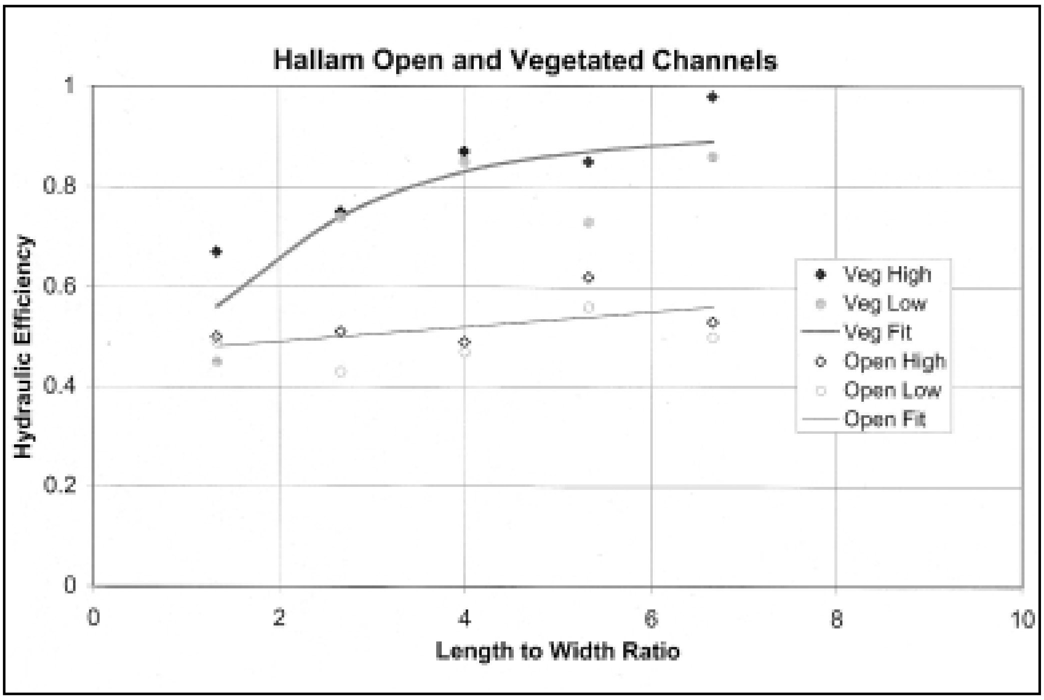

Figure 4.3. Hydraulic efficiency of vegetated and open channels

In both channels there is perhaps a tendency for hydraulic efficiency to be higher at the higher flow rate, although the effect is not large. The high flow rate corresponds to a hydraulic loading of about 1500 m/yr, or a nominal velocity of 0.004 m/sec along the channel. The low flow rate is half this value. It may be that disturbances caused by wind or sampling activities have relatively less effect on flow behaviour at the higher flow rate.

Conclusions

Measurements of flow behaviour in the vegetated and open channels at Hallam indicate that:

- the hydraulic efficiency of the vegetated channel increases with length, and at the maximum length to width ratio of 6.7 the flow behaviour approaches plug flow through the full storage volume of the channel. This is close to optimum flow behaviour for effective treatment.
- the hydraulic efficiency of the open water channel is consistently lower than that of the vegetated channel, and the length to width ratio has only a small effect. Optimum flow conditions have not been achieved in the open water channel, although the channels are the same in all respects except vegetation.

Reference

Persson, J., Somes, N.L.G. & Wong, T.H.F. 1999, 'Hydraulic Efficiency of Constructed Wetlands and Ponds', Water Science & Technology, vol. 40, no. 3, pp. 291-300.

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WATER SENSITIVE URBAN DESIGN

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

by
Tony Wong
Peter Breen
Sara Lloyd

Report 00/1

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

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

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

NEW WORKING DOCUMENT

MODELLING VICTORIAN ANNUAL RAINFALL DATA

by

Ratnasingham Srikanthan
Tom McMahon
Mark Thyer
George Kuczera

Working Document 01/1

Annual rainfall data from twenty stations with long records were analysed with regard to wet and dry spells and long-term persistence. Small changes in the means and standard deviations over time were observed from the time series plots of the data.

The Hidden State Markov (HSM) model was fitted to the data and the results indicated the absence of two state persistence in the data. One hundred replicates of annual rainfall data were generated using the HSM and the widely used first order autoregressive model. The autoregressive model preserved the moments of the data better than the HSM model as these were directly input to the model. The low rainfall sums were satisfactorily reproduced by both models.

A further study is in progress using a number of stations selected across Australia and carrying out the HSM calibration with different starting months.

Copies available through the Centre Office for $22.00

PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM McMAHON

Report by Sri Srikanthan and Tom McMahon

Project: 5.2 National data bank of stochastic climate and streamflow models

Daily rainfall data generation

After completing the modelling of annual rainfall, we have been working on the generation of daily rainfall data at a site. The most commonly used model in the overseas literature is the two-part model. As the name implies, the first part of the model generates the occurrence of wet and dry days and the second part generates the rainfall on wet days. Even though this model preserves the daily characteristics well, it fails to preserve the characteristics at the monthly or annual level. To overcome these inadequacies, we developed the transition probability matrix method. The transition probability matrix (TPM) method has been shown to work well for Australian conditions. It was recently modified by Dr Walter Boughton to preserve the annual standard deviation. The modified version is also assessed as part of the project.

Daily and monthly modelling

Dr QJ Wang and Dr Rory Nathan (WN) developed a mixed model using daily and monthly data which explicitly models the daily and monthly characteristics. This model was applied to only a few stations in Victoria and it is being assessed for its suitability for application Australia wide.

Application of models

The above two models were applied to twenty-one daily rainfall stations (*Figure 5.1*) selected from the high quality stations identified by the Bureau of Meteorology Research Centre. Initial assessment of the results indicated that both the models preserved most of the characteristics at the daily, monthly and annual levels. However, the mean daily rainfall for different types of wet days are not preserved by the WN Model. Modifications are made to the model to explicitly model the mean rainfall on different types of wet days. The modified model is being assessed at present.

Although this work is continuing, we can conclude at this stage that the TPM method with the adjustment for the annual standard deviation performs the best.

Modelling medium-long term persistence

The project team had a meeting with Dr Ashish Sharma, University of New South Wales, regarding his work on modelling daily and monthly data. His group has developed a daily rainfall occurrence model and a monthly model. Both take into account medium to long term persistence and involve a resampling scheme using a non-parametric kernal density estimation technique for data generation. We will be incorporating these models in our model comparisons.

Work has also commenced on the generation of daily climate data and the outcome from this will be reported later.

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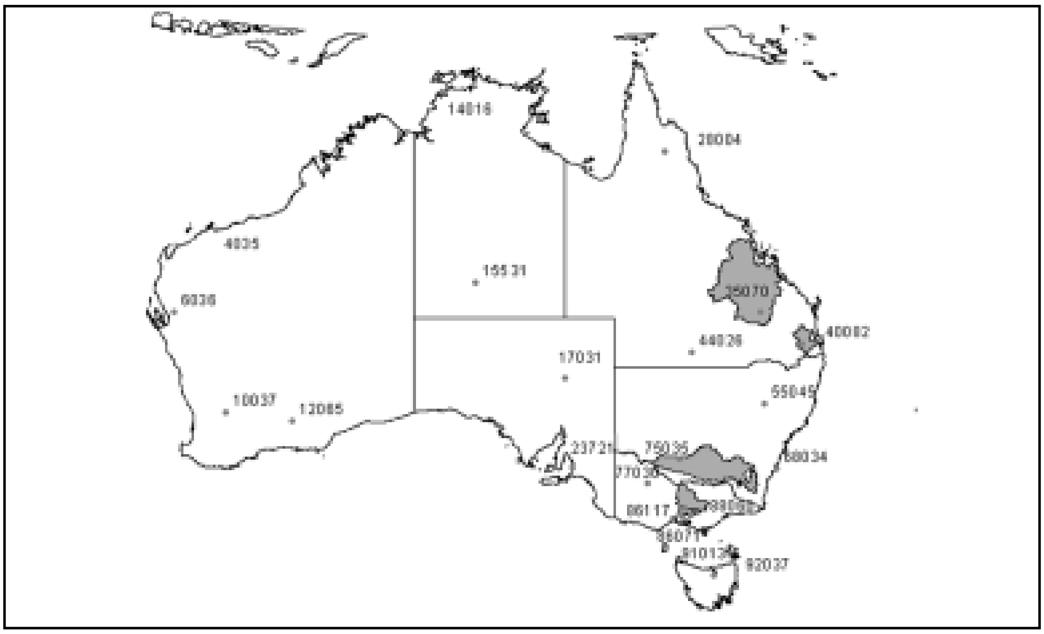

Figure 5.1. Locations of the daily rainfall stations used in model comparisons. Focus catchments are shaded.

IMPROVING URBAN STORMWATER QUALITY BY NON-STRUCTURAL MEANS

The Cooperative Research Centre for Catchment Hydrology has begun a project to evaluate the effectiveness of non-structural measures to improve urban stormwater quality. The project is primarily funded by the Victorian EPA.

Non-structural stormwater management measures include community awareness campaigns, planning controls, legislative controls, enforcement campaigns, etc.

The use of such measures is now widespread and can have many advantages, such as:

- Minimising pollution at the source.
- Minimising pollution that is often difficult or expensive to trap via structural measures (eg constructed facilities) in an urban environment (e.g. fine sediment, filterable reactive phosphate, groundwater contamination).
- Relatively low life cycle costs.
- The ability to quickly change strategy, if needed.
- The ability to involve the broader community in urban stormwater management (e.g. in education campaigns).

Despite these advantages however, there has been little work done to measure the effectiveness of these non-structural measures, and to assess the timeframe required to produce the desired outcomes. This lack of information is currently a major impediment to urban stormwater managers.

The CRC is currently seeking the assistance of stormwater managers who can provide information on attempts to measure the outcomes and life cycle costs associated with non-structural measures to improve urban stormwater quality.

If you can assist the CRC in this important project, please contact André Taylor andretaylor@iprimus.com.au or Tel or Fax: 08 9386 7565.

CONFERENCE PROCEEDINGS

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

27-29 August 2001

Brisbane, Queensland

Copies of the recent Stream Management Conference proceedings are now available for sale from the Centre Office.

The 700+ page, two volume set contains over 120 papers. Copies cost $110 (includes GST and postage) and can be ordered by contacting the

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

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PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Myriam Ghali

Stream values

This article is about identifying the value of streams. So why am I looking at values as part of the River Restoration Program of the CRC for Catchment Hydrology? Well, if you had gone to the recent stream management conference in Brisbane, you would have seen oblique references to identifying stream 'values' in paper after paper. This is because the basis of stream restoration practice and priority setting (including ecosystem services) is identifying and comparing the many, often conflicting, values of streams. My thesis is on priority setting for stream rehabilitation - so a crucial first part of this task is to identify stream values.

Conflicting management objectives

Streams are managed for sometimes conflicting reasons: economics, social expectations, sustainability of healthy stream environments and ecosystem services. Managers must decide which of these often conflicting goals take priority, and what is the most cost-effective strategy for achieving those goals. These priorities relate directly to one's *values*. Table 6.1 lists some generic definitions of values that are most relevant to stream management:

Definitions of values

The diversity of the above dictionary definitions highlights two issues. Firstly, there is no single, definition that covers all aspects of values. Consequently, there is no one method to identify all values.

Second, the definitions of value reflect two dimensions of human reasoning:

(a) Human's principles and judgment of what is important in life. (These principles differ from one person or group to another due to our own perception of particular entities and the way we are influenced through personal, professional, environmental and other experiences).

(b) The actual or equivalent value of something. (In other words, the term value is used to assign a relative value to an asset).

Interest groups

Typically, in stream management, there are many parties involved, such as government and interest groups representing industry, agriculture, forestry, conservation, ecology, energy and trade. These groups may represent different and sometimes conflicting interests. Thus, stream managers should recognise all relevant values in his/her streams. To assist with this task, values need to be categorised.

Categories of stream values

Three major categories of value - social, economic and environmental values - have been identified as shown in *Figure 6.1*. These categories encompass the diverse values (reflecting the worth of assets and personal interests) in a healthy stream. It is important to state that there are overlaps between the three major value categories as well as in between the subcategories.

Identifying and assigning relative values to social, economic and environmental aspects of streams is a challenging task, but essential for effective asset management. To a certain extent, market values can be found in all of the three aspects and are usually determined through the amount of money people are willing to pay for goods.

Assessing non-market values

One of the challenges related to values is the assignment of relative numerical forms to environmental non-market values such as intrinsic values, certain ecosystem services, and habitat. There are economic, deliberative and environmental techniques available, which aim to convert non-market values into numerical forms. Some techniques for assigning these values are shown in Table 6.2.

TYPE OF VALUE	EXAMPLES OF APPLICATION TO STREAMS
• one's principles or standards	• healthy stream ecosystems must be protected at all costs
• one's judgement of what is valuable or important in life	• biodiversity is more important than profit earned from leisure activities
• the desirability, or the qualities on which these values depend	• to conserve a pristine stream, one is willing to accept poor road access to the stream
• the amount for which a thing can be exchanged in the open market	• $ amount that an irrigator is willing to pay for water
• the value equivalent to another thing	• perceived intrinsic values of a stream versus the amount of time volunteers work on that stream
• the monetary value of the service provided	• revegetated riparian zone assists in flood mitigation
• the ability of a thing to serve a purpose or cause an effect	• stream supplies water and maintains water cycle

Table 6.1: Generic definitions of values and relevant examples.

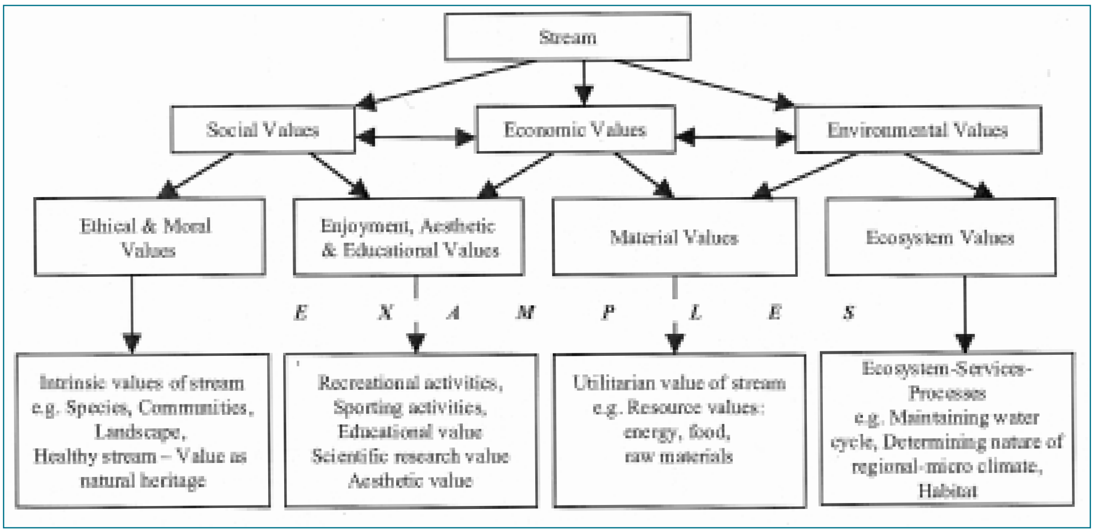

Figure 6.1: Value categories of a healthy stream.

ECONOMIC TECHNIQUES	DELIBERATIVE TECHNIQUES	ENVIRONMENTAL TECHNIQUES
Energy-based valuation (energy required to produce a commodity)	Consulting (eg. public meetings, landholder meetings, special interest groups)	Comparison to external thresholds, benchmarks and standards
Replacement value	Surveys (eg. determining value understanding, attitude, etc. across certain groups)	Expert panel
Willingness-To-Pay (WTP)	Interviews (eg. background information on value understanding, perceptions)	Ranking, scaling, weighting and rating of criteria (eg. naturalness, rarity, diversity)

Table 6.2: Sample techniques to convert environmental non-market values into numerical form.

Monetary versus other assessments for environment values

In rehabilitation planning, disagreements can occur between the users of the environmental and economic techniques on the question of converting environmental non-market values to monetary values (a device to make non-market values tradable or comparable with other goods). Only a few environmental functions of streams can be considered tradable. The understanding of the importance of environmental non-market values, such as ecosystem services, functions and processes, as essential parts of the whole ecosystem, must first be recognised by the whole community. Only then can economic techniques be pursued to create appropriate priorities for rehabilitation projects. But economic techniques will continue to dominate until more effective environmental techniques are available to numerically value ecosystem functions, and create a sound basis for trade-offs.

Thus, value definition, classification, and the assignment of market and non-market values are the first steps of any rational and responsible priority setting in stream rehabilitation.

Future work

In future editions of *Catchword* we will continue to report on our exciting "prioritisation-journey" for stream rehabilitation.

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NEW CRC REPORT

THE CALCULATION OF STREAMFLOW FROM MEASUREMENTS OF STAGE

by

John Fenton and Bob Keller

Report 01/6

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

The main aims of the Project were to:

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

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

Copies available from the Centre Office for $27.50

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PROGRAM 7

COMMUNICATION AND ADOPTION

Program Leader DAVID PERRY

The Flow on Effect – November 2001

Our website - an update

Summary

The CRC has recently included some very useful features on its website. CRC reports can now be downloaded directly from the CRC's website and the site's search engine will now search pdf files - valuable for finding information using key words or phrases.

Those of you who regularly read this section of *Catchword* may recall articles where I have described the CRC's website and its value as an information seeking tool. In keeping with the CRC's commitment to a 'cutting edge website' there has been another update of practical value.

Our publications database

The CRC has now published all of its reports since July 1999 on our website as pdf files at www.catchment.crc.org.au/publications. Whilst that may not seem cutting edge, what is impressive is the way visitors to our site can access our reports. The Adobe Acrobat files (i.e. pdf files) are stored in a database that can be interrogated in a number of ways.

The simplest search of the database uses the research program names. Each of the initial and current CRC's programs are listed in a drop-down menu. Choosing one will take you to that research program's page where all of the relevant publications are listed including their report number, title, authors, and a link to the pdf file for downloading. There is also a link to more information about the report including an abstract or summary.

Other simple searches

Users can also search by the report type ie. technical or industry report, working document, video or 'other' such as maps or conference proceedings.

Alternatively, if you are just interested in the range of reports from the current CRC, the third simple search choice lists all of the CRC's reports. These can then be arranged in order of publication (report number) or alphabetically by title. Where a pdf file is available for downloading, a link is given. Over the next few months we will continue to make the initial CRC's most popular reports (1992-1999) available for downloading. As an example, most of the initial CRC's popular industry report series are already available on-line.

Advanced searching

Using the advanced search at the bottom of the publications page, users can search our website by using a word from the publication title, or by one of the authors names. For example, you can list all of the reports where Russell Mein was a contributing author, by searching on 'mein' in the authors/presenters field.

The database can also be searched using the National Library's keywords. The keyword search facility will return all of the reports where the keywords you have chosen are part of their publication details. As an example, a search using the keyword 'modelling' will return a list of 13 CRC publications, twelve of which are available as Adobe pdf files

List all publications for downloading?

Finally, there is a simple command which will take you to a list of all of the CRC's reports that can be currently downloaded. At present there are 38 of the 52 publications available for downloading. We will add new CRC reports as they are published.

Searching the CRC website

Another major update has involved the site's search engine. It now searches all of the websites pages including pdf files. This facility can be accessed from our home page. At first glance it may not seem that impressive, however imagine if you want to find information about the CRC's research on 'sediment movement'. Using the new search engine, 'sediment movement' will return a list of over 70 hotlinks to pages ranging from the CRC's project sheets describing the research, to *Catchword* articles that explain the research, and also to CRC reports in which sediment movement is mentioned. This is a quick way to get an appreciation of what information on a particular topic or issue is available through the CRC.

Visitors to our site

Visitors to our website come from all around the world. During October over 3100 different people logged on to our website. 895 (28%) visited the site on more than one occasion. Since July 2001 over 4500 CRC reports (as pdf files) have been downloaded. It very rewarding to see our website being used as a tool to meet information needs.

Thanks

Naturally these things don't happen by themselves. My sincere thanks to Maeve O'Leary who designed the publications database and to our esteemed webmaster at CSIRO, Daniel Figucio, who makes it all happen.

To access our publications database please visit www.catchment.crc.org.au/publications

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POSTGRADUATES AND THEIR PROJECTS

Our postgraduate for November is:

Wijedasa Hewa

I graduated with a B.Sc. (Civil Engineering) in 1981 from the University of Peradeniya in my home country, Sri Lanka (which is, as you perhaps know, a beautiful tropical island near the southern tip of India).

After graduation, I joined the Irrigation Department of Sri Lanka as a junior irrigation engineer. I felt privileged then because the irrigation sector was booming in those days and the Irrigation Department was the major institution responsible for the management of irrigation water in Sri Lanka. The involvement of my ancestors in irrigated agriculture for some generations also inspired me to join the irrigation sector.

In the first three years I had the opportunity to obtain experience in dam construction and infrastructure design for a new reservoir construction project. It was really a privilege to be selected as the engineer in charge of managing the largest reservoir network within the Department comprising 19 reservoirs. I enjoyed working with irrigators for six years there. Also, I had rare opportunity to work with the United States Agency for International Development in this period. Working nine years continuously in the field, and the desire to have more knowledge in water resource management, finally pressed me for a change.

I enrolled in the Master of Science program at Utah State University, U.S.A. in 1991 where I worked with Assoc Prof. Marian Kemblowski. My studies in groundwater were completed after two years.

After returning to my home country, I was mainly involved with water resources planning in the previous Department. In this period, I realised that the process for environmental impact assessments in the irrigation sector was very cumbersome. The challenges I faced in this area inspired me to continue research on environmental flow aspects.

Finally I arrived here, as a PhD student at The University of Melbourne involved in the CRC Program 3: Sustainable water allocation.

My research is on ‘ Implications of water transfers on environmental flow: The case of Goulburn–Murray Irrigation Scheme’. I am trying to quantify impacts of possible permanent and temporary water transfers on river flows. I have already completed two years work. My supervisors are Assoc Prof. Hector Malano, Prof. Tom McMahon, Dr. Hugh Turral (The University of Melbourne) and Mr. Garry Smith of Goulburn-Murray Water.

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WEB SEARCH ENGINE UPGRADED

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

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

www.catchment.crc.org.au

NEW WATER ALLOCATION RESEARCH REPORT

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

by

John Tisdell
John Ward
Tony Grudzinski

Report 01/5

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

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

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

CRC PROFILE

Our CRC Profile for November is:

M. P. Seker

I was born in Sri Lanka and after completing University studies I worked on a dam construction project for about two years. I left Sri Lanka in 1986 to undertake full time study at the Asian Institute of Technology in Thailand. After completing my Master of Engineering in water resources engineering in December 1987, I went to India and spent about six months there.

In late 1988, I migrated to Australia and Geoff Earl (CRC Board Member) offered me a job within the Salinity Section of the Investigation Branch of the Rural Water Corporation in Victoria. My first project was to estimate the average annual saltload exported from the Barr Creek (Single largest point source entering the River Murray) catchment. As an outsider to the salinity issues in Australia, it was very difficult for me to accept that a small catchment of about 70,000 ha with irrigated perennial and annual pastures could export about 160,000 to 200,000 tonnes of salt per year. However, after a number of attempts to verify the estimate and many discussions with colleagues I was satisfied with my calculation. The experience that I had with the Barr Creek project had heavily influenced my professional career direction, and I decided to continue to work in land management activities over the next few years.

In early 1990, I decided to move to Kerang for a year to work in one of the Rural Water Corporation's area offices, mainly to live in a salinity affected catchment and gain practical understanding of the impacts of salinity on the catchment and local communities. The first two days of life in Kerang were really tough for my wife who had just arrived in Australia from India. However, local community support completely changed our initial opinion about Kerang and within a fortnight we settled down and made a number of friends, including friends outside work. During the next twelve months I was mainly involved in the design and technical support for construction of water supply and drainage systems.

We moved back to Melbourne in 1991 and I continued work with the investigation branch of the Rural Water Corporation on a number of catchment management projects including development of many conceptual models to investigate the flow and salinity movements in northern Victoria. During the period with the Rural Water Corporation I was fortunate to work in a variety of projects under the supervision of industry experts and gain a good knowledge of catchment management issues, especially salinity.

After working for about six years in Melbourne, the changes in the Victorian Water industry provided an opportunity to move to the water resources management area. In 1995, I moved from Melbourne to Tatura to work in the Production Management Unit of Goulburn-Murray Water, the largest Rural Water Authority in Victoria. Its region covers 68,000 square kilometres from the Great Dividing Range north to the River Murray, and from Corryong downriver to Nyah near Swan Hill. During my period with G-MW, the changes across the water industry, especially the development and implementation of Bulk Water Entitlements (BEs), the Murray-Darling Basin Ministerial Council (MDBMC) cap on diversions, and recent initiatives by the Victorian Government on water savings in irrigation systems, have been kept my professional career challenging and interesting. No doubt the future management of our limited water resources will add more complexity and challenges to the work of all land and water managers.

In Victoria, it is practically impossible for individual Rural Water Authorities to identify effective solutions to present complex land and water management issues unless they work with external research agencies. The new Cooperative Research Centre for Catchment Hydrology is in a good position to provide that service to land and water managers throughout the country.

In 2000, I was seconded to the CRC for Catchment Hydrology at Monash University to work on the early stages of Project 3.1 "Integration of Water Balance, Climate and Economic Models" with other industry and research staff. In my experience over the last two years, the professional relationship which the CRC has encouraged between its researchers and water agency staff, has been evident. It has already provided me with the opportunity to influence researchers to work on areas which are relevant to our catchment problems. This demonstrates the willingness of the new CRC to work cooperatively with the practitioners on land and water management issues.

My CRC for Catchment Hydrology involvement now focuses on the adoption of research outcomes in the rural water management and land management field. I have particular interest in projects 1.1, 2.3, 3.1, 3.2, 5.1 and 5.2 and their integration in the Goulburn-Broken focus catchment.

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WHERE ARE THEY NOW?

Report by Nick Austin

I'm in Dubbo, the heart of NSW picturesque central west, where, for three short years I've led the joint-agency Water Use Efficiency Advisory Unit. The Unit's work involves irrigation-related research, advice and input to policy development. There is considerable commonality between our activities and those in CRC Program 3: Sustainable Water Allocation.

Our activities include:

- Providing information to irrigators on irrigation methods and technologies, and water access and licensing;
- Coordinating research activities relevant to efficient use of irrigation water;
- Collecting and collating data from Australia and overseas on irrigated agricultural water use efficiency; and,
- Disseminating irrigated agricultural water use efficiency data to extension staff and related irrigation and water management organisations.

A recent example of the Unit's work has been the Volumetric Conversion process, in which some 9,000 irrigation licences in unregulated streams were converted from an area to volume basis. Because of a paucity of water use data, a daily water balance model was used to estimate water requirements for the state's irrigated crops, and as the basis for annual allocations.

Efficient use of water (producing more from less) has become a priority in NSW. There are two main reasons for this:

1. The State's water resources are fully (or, in many instances, over) committed, and increased efficiency is seen as a way to balance competing demands for a scarce resource; and,
2. Irrigation, as the major user of freshwater resources, has had a detrimental impact on inland waters (changed flows, eutrophication, turbidity and salinity). Increased efficiency is expected to reduce the extent of off-site impacts.

NSW accounts for almost half of Australia's irrigation water use, but returns only about 30% of the national value of irrigated agriculture. The state receives an average return of only $290/Ml compared with the $680/Ml realised in the remaining Australian states, because a greater proportion of water in NSW is used on lower value crops.

Sharing water equitably between a diverse range of 'users' (including the environment) is a major challenge not only in Australia, but also overseas. Last year I was fortunate to receive the Australian National Committee on Irrigation and Drainage (ANCID) Travel Fellowship Award, and spent May to July this year in North America (Utah, Idaho and California) and in South Africa. The most striking observation was the similarity in the challenges relating to sharing water. All states and provinces I visited were facing a significant change in emphasis, from water resource development to water resource management.

In NSW, one of the obstacles to the effective and equitable management of water resources is a shortage of suitably skilled and experienced professionals; the demand for human resources is outstripping the supply. This may be good news for graduates of the CRC for Catchment Hydrology, but does pose challenges for the effective implementation of water reforms. [While on the issue of employment, the Unit has a couple of exciting vacancies - please contact me if you're interested in details!]

And, occasionally, I get time to view some of NSW water resources first-hand when I dust off the kayak and go for a paddle on the Macquarie.

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DOWNLOAD CRC REPORTS

All of the current CRC's reports (1999-present) are able to be downloaded from our website www.catchment.crc.org.au/publications

You can use our search engine to find the exact report you are seeking or list all reports that can be downloaded.

MISSION

THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY WILL DELIVER TO RESOURCE MANAGERS THE CAPABILITY TO ASSESS THE HYDROLOGIC IMPACT OF LAND-USE AND WATER MANAGEMENT DECISIONS AT WHOLE-OF-CATCHMENT SCALE.

Hydrology is the study of the properties and laws of water, its distribution, movement across and impact on the earth's surface.

The CRC's main goal is to produce a region-appropriate decision support system to predict the movement of water, particulates and solutes from land to rivers. This system needs to link the impacts of climate variability, vegetation, soil and water management in an integrated package.

THE INDUSTRY-IDENTIFIED ISSUES TO BE ADDRESSED BY OUR RESEARCH ARE:

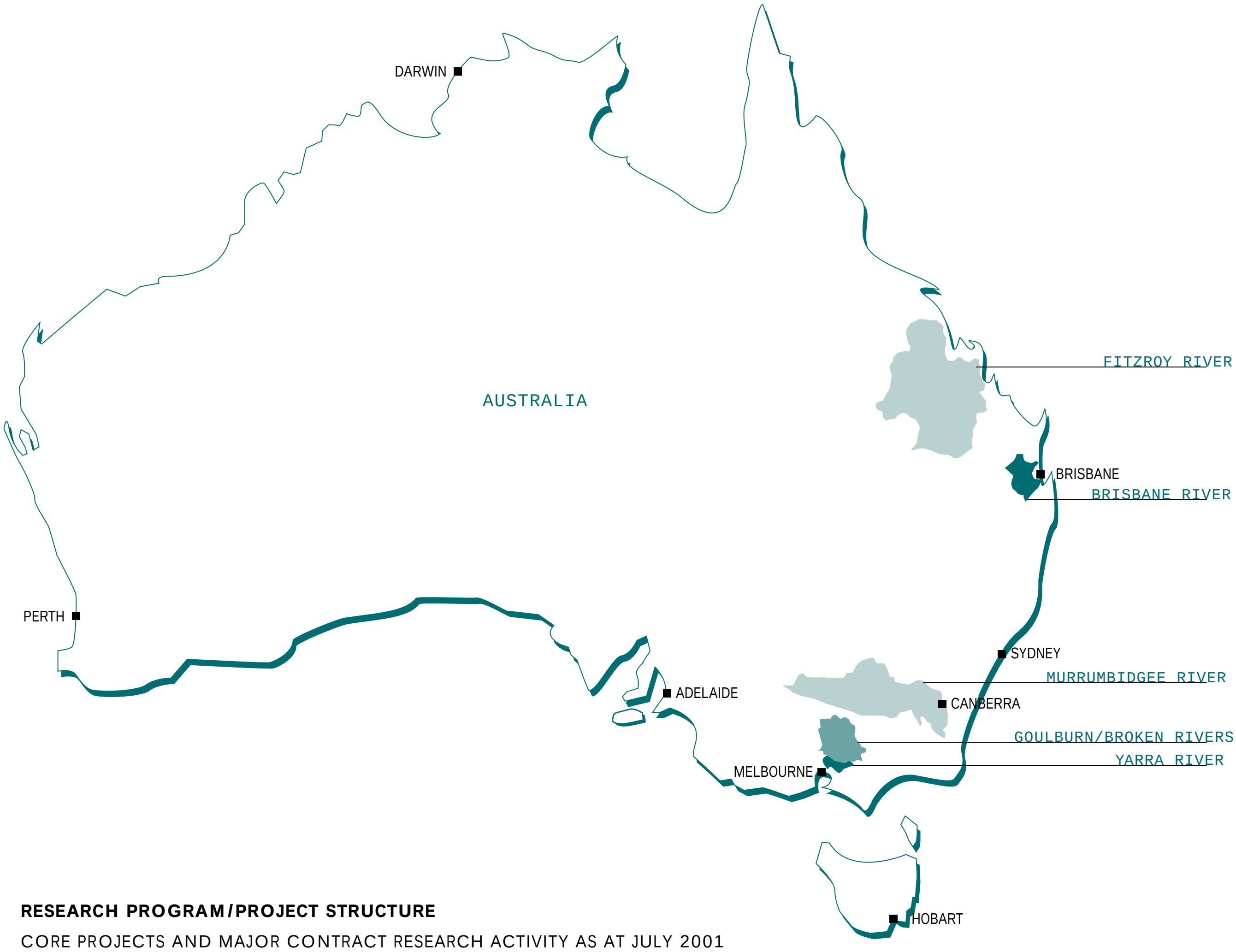
- sustainable and efficient water allocation
- land-use impacts on rivers, especially after land-clearing
- climate variability (the potential to reduce hydrologic risk)
- urban runoff quality
- river restoration

OBJECTIVES

To achieve its mission, the CRC will:

- mount a quality research program, targeted to meet national objectives in catchment hydrology, by focusing on achieving predictive capability at whole-of-catchment scale
- maximise the synergies of collaboration among its Parties and with related organisations
- involve end-users in the identification, formulation, conduct and use of its research activities
- provide training to increase awareness of, and the national skill base available in, catchment hydrology
- train and equip postgraduate students as future leaders in land and water management
- seek to sustain continuity of research in catchment hydrology consistent with the widespread and persistent nature of land and water problems.

CRC FOR CATCHMENT HYDROLOGY FOCUS CATCHMENTS



RESEARCH PROGRAM/PROJECT STRUCTURE

CORE PROJECTS AND MAJOR CONTRACT RESEARCH ACTIVITY AS AT JULY 2001

PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

1.1 Development of a catchment modelling toolkit

1.2 Scaling procedures to support process-based modelling at large scales

1.3 Development of an environmental management support system (EMSS) for catchments in South East Queensland

1.4 Modelling and estimating sediment and nutrient loads in South East Queensland catchments

PROGRAM 2

LAND-USE IMPACTS ON RIVERS

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

2.2 Managing pollutant delivery in dryland upland catchments

2.3 Predicting the effects of land-use changes on catchment water yield and stream salinity

2.5 Nitrogen and carbon dynamics in riparian buffer zones

2.6 Predicting the combined environmental impact of catchment management regimes on dryland salinity

PROGRAM 3

SUSTAINABLE WATER ALLOCATION

3.1 Integration of water balance, climatic and economic models

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

PROGRAM 4

URBAN STORMWATER QUALITY

4.1 Stormwater pollutant sources, pathways and impacts

4.2 Stormwater best management practices

PROGRAM 5 CLIMATE VARIABILITY

5.1 Modelling and forecasting hydroclimate variables in space and time

5.2 National data bank of stochastic climate and streamflow models

PROGRAM 6 RIVER RESTORATION

Project Group A: Stream Restoration – Procedures and Evaluation

6.1 Developing criteria and concepts for planning the evaluation of stream rehabilitation projects

6.2 Optimising urban stream rehabilitation planning and execution

6.3 Restoration ecology in the Granite Creeks, Victoria

6.4 Evaluation of riparian revegetation in a South East Queensland catchment

Project Group B: Tools for Stream Restoration

6.5 Hydraulics and performance of fishways in Australian streams

6.6 Developing tools to predict scour of rehabilitation works

6.7 Developing an environmental flow methodology: a trial on the Campaspe River

6.8 Research to improve the effectiveness of Australian fishway design

PROGRAM 8

EDUCATION AND TRAINING

8.1 Capacity building, education and training

8.2 Public participation and community change

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

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OUR MISSION

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

OUR RESEARCH

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

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

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

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

Associates: SA Water • State Forests of NSW

CRC
AUSTRALIA