NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 91 FEBRUARY 2001

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

Inside...

'DELIVERING' RESEARCH – WHAT AND WHEN

'If we knew in advance what we were doing, it wouldn't be called research' is a somewhat tongue-in-cheek quotation (source unknown), occasionally used in jest. Its more serious message conveys the often high levels of uncertainty which prevail in research activities; investigation of unknown behaviour and/or yet-to-be developed methodologies requires an adaptive approach, which allows for changes of direction as knowledge develops. The CRC for Catchment Hydrology has adopted such an approach.

The planning of the set of projects which comprise the bulk of the CRC's research program took place over two years, the most intensive activity being in the last half of 1999. In February 2000, the Board signed off on the funding and resourcing of an integrated set of projects in six research programs. In virtually all cases, this funding is for a three year period. At the end of that time (ie Dec 2002), some projects will continue (after review and refocussing as appropriate), others will have been completed, and new ones will start.

The point to stress here is that we are about one year into an initial three-year program of work. Achieving 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 – is expected to take us three years or so beyond that! Research and development takes good people, good teamwork, and time.

The National CRC Program accommodates the time requirements of comprehensive research programs by funding CRCs for seven years (with scheduled reviews built in to monitor progress). Such a period also is important to attract and keep good research staff, and to include the successive projects that build on the expected outcomes of the initial set. This timespan also gives considerable flexibility in formulating project work and allows our CRC to exploit opportunities that may develop, or to fill knowledge gaps that remain at the end of the initial project set.

So what can stakeholders expect from the CRC over the next several years?

Firstly, they will be informed on progress of each project (through *Catchword*, seminars, conference presentations, industry and technical reports, and journal papers).

Secondly, useful and usable research outcomes will be developed for practical application as they become available.

I'd like to emphasise that we are not putting all our eggs in the one basket. Each research project will have usable outcomes in its own right, in addition to contributing to the prime objective to meet our mission – a toolkit for predicting catchment behaviour for different land management scenarios, under a highly variable climate.

Thirdly, there will be continuing evaluation and planning to focus our activities to best meet the CRC's objectives. This will include a (third) Future Issues Workshop to directly include views from organisations 'outside' the CRC. The CRC Program aims for national benefits, and we are keen to match our research with national needs as best we can.

I'll finish this article with a further word on timing. The issues the CRC is tackling are important ones, and they are current. Managers want the sort of capability we are striving for as soon as possible, and preferably now! We appreciate their position and their needs. The land and water problems they face require a targeted and successful research program sustained over a number of years. That is what we are undertaking in the CRC for Catchment Hydrology.

Russell Mein
Tel: (03) 9905 4980
Email: russell.mein@eng.monash.edu.au

CRC PUBLICATIONS LIST

Reports, videos and software, available from the CRC, are listed in our 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.

All of the Centre's products can be ordered through the Centre Office.

Contact Virginia Verrelli on:
tel 03 9905 2704
fax 03 9905 5033
email
virginia.verrelli@eng.monash.edu.au

Centre Office Postal Address:
CRC for Catchment Hydrology
Department of Civil Engineering
PO Box 60
Monash University, 3800
Victoria

PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Rob Argent

Project 1.1 Twelve Months On - Where's our modelling toolkit?

Hello, all, and happy new Millenium to those who can count. Given that twelve months have passed since the beginning of Project 1.1 "Development of a catchment modelling toolkit", it is possibly a good time to review our progress of the last year, to see how the catchment modelling toolkit is shaping up, and to answer the question "So, where is our modelling toolkit?".

We made some good progress over 2000, despite the difficulties of having a group of researchers, largely new to the CRC, spread over four States and one territory. Rob (Vertessy), Robert (Argent) and a few others quietly kicked off the project in January 2000, but we really only got going with our first project gathering at the CRC Annual Workshop, in April.

Review and information gathering

2000 was largely a year for reviewing and background information gathering, as we started to get up to speed with local, national and international developments of integrated modelling toolkits for natural resources management. We had some idea of what was going on from our various work over the last five-ten years. It became a different matter, with a different level of detail, when we started looking closely at features, designs, and other toolkit aspects with a view to adoption or development.

Surveys

A large part of the start of the project was wrapped up in three surveys (Task A, in our project agreement). These surveys were undertaken to gauge the attitudes of the land and water industry and researchers to current catchment modelling tools. The surveys were targetted at catchment managers, model users, model developers and model writers. About 100 people, out of 280 invited, took time to complete the surveys. The outcomes of the surveys are available as a project report (as are the other items mentioned below), but in brief, the results were as follows.

Key catchment management questions for models

Survey 1, together with previous investigations, gave the clear message that the issues of greatest importance for modelling were:

- catchment analysis of nutrient and sediment load under different land uses
- estimation of flow and nutrients at any point in a catchment
- ecological-hydrological interactions and bio-indicators, and catchment salt generation and transport.

Survey 2 targetted model users and sought to determine what and how models were being used in industry. Overall, it was found that model parameterisation and interpretation of results from models are considered challenging, and user interfaces and documentation considered adequate.

Survey 3, with an internal focus, sought to identify current software engineering practices by looking at the initiation, design, implementation, and deployment of current and future models. The survey highlighted the general lack of sound software engineering and model notation approaches used within the CRC.

Other tasks

Three further key areas of investigation were undertaken during the year. These were designated as part of Task B, and covered:

- Identification of the features thought to be desirable in the modelling toolkit (B1)
- Reviewing modelling frameworks currently available or undergoing development, (B2), and
- Identifying selection and testing criteria for evaluating and comparing candidate frameworks (B3).

Task B1 covered a broad range of issues including component based modelling, version control, maintenance and testing, peer review, and other aspects related to the use, adoption, and deployment of a modelling toolkit.

Work under B2 highlighted the range and depth of options that are available in the world of natural resources modelling frameworks and environments.

The world of environmental modelling frameworks is HOT at the moment, and we are in there (boots and all), at the heart of an environmental modelling revolution. The outcome of the investigation (as part of B3) was the adoption of half a dozen candidate modelling frameworks for testing during 2001. The biggest buzz for the year (for me in Project 1.1, anyway) was attendance at the fourth GIS-Environmental Modelling Conference (GIS-EM4), in September. At this conference, modelling frameworks were THE hot topic, and the week was a huge endorsement of what we are doing in Project 1.1.

Work in 2001

The main focus of our tasks over 2001 will be testing and elimination of some of the model candidates. To do this we're working on a testing protocol that will be used to put alternative frameworks through their paces. We aim to

gather both a depth and breadth of knowledge on the alternative frameworks through implementation of a range of simple and complex models.

Other activities for 2001 include, early on in the year, development of our Adoption and Communication strategy. Rob (V) will be aiming to strengthen our links with international modelling groups through use of a travel grant that will take him to North America during the year.

I look forward to meeting many of you at this year's Annual Workshop, where you'll be thrilled, amused, (and confused?) with the latest news from Project 1.1.

Rob Argent
Tel: (03) 8344 7115
Email: r.argent@unimelb.edu.au

PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Peter Hairsine

International trends in soil erosion and sediment delivery research

I recently attended the American Society of Agricultural Engineers' International Soil Erosion Symposium in Hawaii. The meeting was a gathering of water and wind erosion gurus from around the world, though one had a sense that it was also the New Year escape for winter-weary north Americans.

Frameworks for sediment transport

The conference was organised with papers in parallel sessions. Many of the USDA people presented papers on sub-factors in sub-models of a component of something. Unfortunately many engineers (including myself?) continue to view the world as a machine that can be described if only we break it up into enough components. The USDA's WEPP (Water Erosion Prediction Program) model and RUSLE (Revised Universal Soil Loss Equation) were the dominant frameworks presented for describing sediment transport. There where some exceptions including my own paper on "An alternative approach to modelling sediment deposition and related sorting".

Systems approaches

The Europeans seemed to be taking much more of a systems approach with geomorphology as a starting point – though there remained an undercurrent of process modelling. There were very few papers linking hillslope erosion with in-stream water quality. This was surprising given the worldwide funding base has shifted to pollutant transport at a catchment scale. Another notable absence was the use of sediment tracers. It seems tracer people go to geochemistry conferences or geomorphology meetings.

Trends observed

Some notable trends in the meeting were the papers from Russia on model uncertainty, investigations linking surface pore water pressures to erosion rate and surface washoff of nutrients. There were also some morphological approaches to transport pathways being developed by the group at KU Leuven in Belgium.

Tropics and soil erosion

On the field tour we learnt of the radical changes in Hawaii agriculture over recent years. In the last five years sugar cane has disappeared as an industry. The combined pressures of sugar prices and environmental regulation on

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

27-29 August 2001

Hilton Hotel
Elizabeth Street
Brisbane

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

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

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

PLANNING TO ATTEND, SUBMIT A PAPER OR A POSTER?

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

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

NEW CRC VIDEO

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

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

November 2000

CRC Video 00/6

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

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

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

the sugar mills have resulted in the industry folding. Macadamia nuts, pineapples, tropical fruits and eucalypt plantations are now the predominant agricultural industries.

Hawaii is like the Wet Tropics of north Queensland with the surf of Margaret River on a big day. I came back to Australia wondering if tourism will win out over sugar cane here and whether soil erosion knowledge will contribute to the debate.

If you wish to look over the program of the meeting it can be found at http://asae.org/

Please contact me if you wish to obtain individual copies of articles that were pre-published.

Peter Hairsine
Tel: (02) 6246 5924
Email: peter.hairsine@cbr.clw.csiro.au

PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader
JOHN TISDELL

Report by Hector Malano and Wijedasa Hewa

Water Trading in Victoria

Water Trading

Reallocation of water (available for use) is considered the most suitable approach to meeting new demands and preventing further deterioration of river environments. Water trading (transfers) is recognised as an appropriate tool to reallocate water resources. The water sector reforms proposed by the Council of Australian Government's (COAG) in 1994, and the Cap introduced by the Murray Darling Ministerial Council in 1995 are shifting responsibility for irrigation risk management associated with the availability of water from government to irrigators. Among other measures, irrigators have resorted to water trading as a tool to manage risk associated with water supply.

Water is traded both temporarily and permanently. Temporary trading is primarily aimed at meeting seasonal demands, while permanent trading is aimed to meeting demands associated with long-term developments and new ventures. There is also a geographical dimension to water trading which may involve local, inter-valley and inter-state water transfers.

Water Trading Drivers

Temporary water trading was first introduced in Victoria in the 1987/88 season and permanent trading has been allowed from 1991/92. Provisions made in the Water Act of 1989 and the introduction of bulk entitlements were positive steps taken to promote water trading.

Significant increases in both temporary and permanent water trading have taken place in recent years. Figure 3.1 shows water trading trends for the Goulburn-Murray Irrigation District. In the 1998/99 season, 10% of the water used was traded in the temporary market. Permanent trading amounted to about 2% of the total water use.

Table 1 presents some comparisons of water entitlements and water use comparisons for the Central Goulburn, Shepparton and Murray Valley Districts for the 1996/97 season. These figures allow us to glean the behaviour of some drivers for permanent trading. In the Goulburn Murray Irrigation District, water is moving from predominantly saline sheep and cattle farming areas to horticulture and dairy farms which now have a greater than average water entitlement. The water use figures for dairy and horticulture show a similar trend.

A number of factors can be identified as potentially influencing water trading including:

- seasonal water shortages due to low allocation and adverse climatic conditions
- over-draw, carry-over and
- fluctuations in commodity prices. Other farm related factors such as reuse of drainage water, groundwater extraction and on-farm storage can also play an important role.

Presently, we are conducting a survey of irrigators who have participated in water trading in recent seasons to determine the relation between these factors and water trading.

Implications of water trading

Some limitations have been imposed on water trading to avoid possible adverse impacts on the river systems. These impacts include third party impacts as well as impacts on environmental flows.

Security of water supply arising from the activation of unused licences, conveyance limitations, increased infrastructure costs to water users and water quality problems are often cited as the main third party impacts.

Limitations imposed on water trading in order to avoid possible adverse impacts include the demarcation of water trading zones, introduction of transfer penalties, restriction of application rates due to salinity concerns and restriction of trading due to conveyance and environmental flow effects.

The study of these impacts is critical to ensure the sustainability and enhancement of water trading. The results of the irrigator survey will be used in conjunction with system modelling to analyse future water trading scenarios and their potential impact on environmental flows and eliminate potential constraints to water trading.

Hector Malano
Tel: (03) 8344 6645
email: h.malano@devtech.unimelb.edu.au

Wijedasa Hewa
Research Student, Associated Project
The University of Melbourne

Table 1. Water Right and Water Use in 1996/97 Season - Goulburn-Murray Irrigation District.

Area	Water Right (ML/ha)			Water Use (ML/ha)		
	Dairy	Horticulture	Whole Area	Dairy	Horticulture	Whole Area
Central Goulburn	2.84	3.74	2.63	5.44	5.53	4.82
Shepparton	2.56	2.45	2.38	4.99	4.56	3.13
Murray Valley	2.55	3.23	2.12	5.96	4.98	4.80

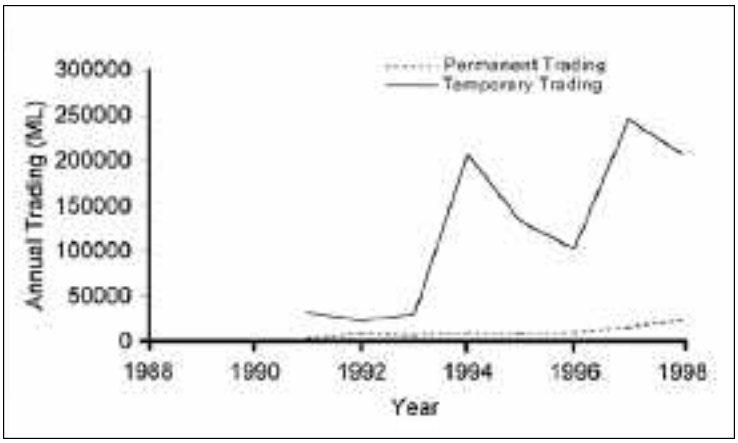

Figure 3.1. Water Trading – Goulburn-Murray Irrigation District of Victoria.

SALINITY DISPOSAL BASIN REPORTS NOW AVAILABLE ON-LINE

The CRC Project S2, 'On-Farm and Community Scale Salt Disposal Basins on the Riverine Plain, was a collaborative project between the CRC for Catchment Hydrology, CSIRO Land and Water and the Murray-Darling Basin Commission.

The outputs of the project include fifteen technical reports covering key issues in the siting, design and management of salt disposal basins.

Reports in this series can be downloaded (free) as pdf files from the CRC website at the address - www.catchment.crc.org.au/disposalbasins

The reports are also available in printed form for $27.50 (inc. GST) from the CRC Centre Office

CRC STAFF DATABASE ON-LINE

THE CRC STAFF DIRECTORY (CONTAINING STAFF CONTACT DETAILS) IS NOW AVAILABLE ON OUR CRC WEBSITE.

The directory includes staff telephone, fax, email and postal addresses and the search feature allows you to search contact details by first or second name, organisation and state.

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

PROGRAM 4

URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Margaret Greenway

Nutrient Removal in Constructed Wetlands: Quantifying the Role of Aquatic Macrophytes

Introduction

The December 2000 *Catchword* report for Program 4 by Peter Breen and Tony Wong addressed an experimental study to quantify the role of aquatic macrophytes in promoting the removal of particulates. This report describes a study conducted to quantify the nutrient removal capacity of aquatic macrophytes such as reeds, rushes and water lillies.

Types of macrophytes

Vegetation is the dominant feature of constructed wetlands, and free water surface flow systems may support a variety of macrophyte types and species including emergent macrophytes (reeds, sedges and rushes), floating leaved attached macrophytes (water lilies), free floating macrophytes (duckweed) and submerged macrophytes ("pond weeds").

Functions of macrophytes

The most important functions of macrophytes in improving water quality are physical, including:
- filtration of particles
- reduction in turbulence
- stabilisation of sediments
- an increased surface area for biofilm growth on stems, leaves, roots, rhizomes;

and metabolic:
- nutrient uptake
- and oxygen release.

Nutrients are essential for plant growth and aquatic plants remove soluble inorganic nutrients (ammonium, nitrite, nitrate, phosphate) either directly from the water column (floating and submerged species) or from pore water in the sediment (rooted species). These inorganic nutrients are converted into organic matter (plant biomass) and rendered relatively unavailable. Nutrient storage as plant biomass is therefore a good indicator of nutrient removal.

Study aim

The aim of the study was to monitor nutrient removal at two different loading rates over a three year period and to determine the proportion of nutrient removal that could be attributed to direct uptake by macrophytes and incorporated into plant biomass.

Field site

- Constructed wetland channels design

  Changes in plant biomass were monitored over three years in a constructed surface flow wetland at Edmonton Sewage Treatment Plant near Cairns. The wetland consisted of three linear channels each 65 m long. Channels 1 and 2 were 5 m wide and Channel 3 was 15 m wide, depth 400-500 mm. Flow rates were 0.12 L/s, 0.22 L/s and 0.56 L/s giving a median hydraulic loading rate of 300 m^2/ha/d in Channel 1 and 500 m^2/ha/d in Channels 2 and 3. Median retention time was 16 days in Channel 1 and 10 days in Channel 2 and 3. The median loading rate was 2.4 kgN and 2.0 kgP/ha/d in Channel 1 and 3.7 kgN and 3.4 kgP/ha/d in Channels 2 and 3. 70% N and 97% P was bioavailable in the form of NO_x and FRP (PO_4) respectively.

- Plantings

  The channels were band planted and separated by open water sections. Initial species included Typha domingensis, Schoenoplectus validus, Eleocharis equisetina, Eleocharis sphacelata, and the floating-leaved attached macrophytes Marsilea mutica (nardoo) and the water lilies Nymphaea gigantea and Nymphoides indica. Each channel had a different configuration of species. Duckweed rapidly colonised the open water.

Methodology

Vegetation mapping and photographic records were conducted on a monthly basis for the first two years, then four monthly, in order to monitor the successful growth and spread of transplanted species and the invasion and colonisation of new species. The area of each plant species was determined from the maps using a GIS computer package.

Plant density and plant biomass (shoots, roots, rhizomes) was determined for each different species in each channel, using quadrats as the sampling unit. The nutrient content (nitrogen and phosphorus) of plant tissue was analysed.

Plant biomass turnover rate and growth rate was estimated from harvesting and regrowth experiments.

Water quality monitoring of influent and effluent was conducted on a weekly basis for all nutrient species and the flow monitored daily. This enabled nutrient loading and net removal to be calculated.

Results

- Biomass and nutrient content

  Dense plant cover was achieved within 5 to 6 months of transplanting individual shoots or clumps. Plant biomass was highest in Typha (1750 g/m^2), followed by Eleocharis (1000 g/m^2) and Schoenoplectus (800 g/m^2) (depending on shoot density) but tissue nutrient content for these emergent macrophytes was relatively low 3.5-4.2 mgP/g and 13.5-15 mgN/g. Marsilea had a lower biomass (370 g/m^2) but higher nutrient content (9.5 mgP and 27 mgN). Duckweed had the lowest biomass (40 g/m^2) but very high nutrient content (14.4 mgP and 43 mgN). The submerged macrophyte Ceratophyllum also had high nutrient content (10 mgP and 31.5 mgN). Duckweed also occurred among the emergent species, and in some sections Ceratophyllum formed a dense subsurface layer between Schoenoplectus shoots. Such a combination of species yielded a biomass containing 51 gPm^2 and 160 gNm^2, indicating a high nutrient removal capacity.

Fig 4.1: Changes in plant density and biomass - initial planting

Fig 4.2: Changes in plant density and biomass - after 3 months

- Growth rates
  Growth rates from the biomass harvesting experiment showed that shoot regrowth in emergent macrophytes could attain pre-harvest biomass within 4-6 months. Eleocharis had the fastest growth rate and Schoenoplectus the slowest. Duckweed had a turnover rate of days.

- Estimation of nutrient uptake
  Plant biomass, nutrient content and turnover time were used to estimate nutrient uptake and incorporation into plant biomass for each plant species in each channel. Assuming an average 6 month turnover time of plant biomass for emergent macrophytes and a conservative value of 14 day turnover for duckweed, total nutrient storage in plant biomass over six month intervals was calculated. The total amount of nutrients stored as biomass in each wetland channel was determined by adding all values for the different plant species.

- Variations in biomass production between channels and timing
  Biomass production varied between channels and time intervals due to the different composition of plant species and the extent of duckweed. During the first five months following planting, biomass production rate was 0.94 kgN and 0.30 kgP ha/d in Channel 1, 0.98 kgN and 0.30 kg P/ha/d in Channel 2, and 1.14 kgN and 0.44 kgP ha/d in Channel 3. Duckweed accounted for 50% biomass production. After two years biomass production rate was higher in Channel 1 and 2 (1.42 kgN and 0.45 kgP ha/d), than in Channel 3 (1.10 kgN and 0.38 kgP ha/d), due to the rapid spread of Typha. After three years, biomass production was highest in Channel 2 (1.8 kgN and 0.65 kgP ha/d) of which 65% was Typha and 30% duckweed.

  Thus as plant biomass increased over the three years, production rate and nutrient uptake capacity also increased. The gradual displacement of open water

CRC RESEARCH SITE (LYNBROOK ESTATE) WINS

Stage 13 of the Lynbrook Residential Estate at Lyndhurst, Victoria was awarded a President's Award at the Victorian Urban Development Institute of Australia's 2000 Excellence Award luncheon last December.

The CRC for Catchment Hydrology has an intimate involvement, through the Urban Stormwater Quality program, in conceptualising the Water Sensitive Urban Design features in this estate, defining their function specifications and providing on-going advice during the design.

www.catchment.crc.org.au/news

TECHNICAL REPORT

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

by

Walter Boughton

Report 00/15

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

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

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

Fig 4.3: Changes in plant density and biomass - after 6 months

Fig 4.4: Stands of Schoenaoplectus with duckweed on the surface and Ceratophyllum beneath provide a high nutrient removal capacity.

section of highly productive duckweed with larger biomass emergent macrophytes did not affect the nutrient uptake capacity of the wetland system. This study however has demonstrated that nutrient removal by wetland plants is maximised by maintaining a variety of macrophyte types and species.

- Nutrient removal efficiency of macrophytes
  By comparing the mass removal of N and P from the effluent with N and P incorporation into plant biomass production it is possible to get some indication of the percentage of nutrient removal attributed to plant uptake. Over the three years total nitrogen removal was 92 kg in Channel 1 and 154 kg in Channel 2 of which biomass production accounted for 43.6 kg (47%) and 41.7 kg (27%) respectively. Phosphorus removal was 22.7 kg in Channel 1 and 33.1 kg in Channel 2 of which biomass production accounted for 14.9 kg (65%) and 14.7 kg (44%) respectively. It is interesting to note that although more nitrogen and phosphorus was removed in Channel 2 this could not be accounted for by the plants. Total plant biomass production in Channels 1 and 2 was similar despite the different loading rates, indicating a finite capacity for nutrient uptake by plants.

Conclusions

This study showed that biomass production (nutrient uptake rate) was independent of flow rate, loading rate and detention time, however in this wetland system receiving secondary treated municipal effluent, nutrients were never limiting (5.3 mg NOx-N/L, 7.5 mg PO_4-P/L) and plant growth and biomass production was probably optimal.

In wetland systems receiving stormwater runoff lower nutrient concentration may limit plant growth and tissue nutrient content, however a knowledge of plant biomass production for a variety of aquatic species can be used to predict the potential nutrient removal capacity of plants within a wetland system.

The design of wetlands should attempt to maximise nutrient uptake by plants by providing areas suitable for floating macrophytes with rapid growth such as duckweed, and submerged macrophytes such as Ceratophyllum, as well as areas dominated by emergent macrophyte species. Thus both deeper open water "ponds" and shallow densely vegetated zones should be incorporated into the design.

This article is a summary of a paper "Changes in Plant Biomass and Nutrient Removal Over 3 Years in a Constructed Free Water Surface Flow Wetland in Cairns, Australia" by Margaret Greenway and Anne Woolley (Qld DNR), presented at the 7th International Conference on Wetland Systems for Water Pollution Control 12-17 November 2000, Orlando, Florida.

Margaret Greenway
Tel: (07) 3875 7492
Email: m.greenway@mailbox.gu.edu.au

PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM McMAHON

Report by Tom McMahon and Francs Chiew

Project updates

This is the start of the second year of the two three-year projects in the Climate Variability Program. Here is a brief update on the research studies in the projects.

Project 5.1 Modelling and forecasting hydro-climate variables in space and time

There are four main research areas in Project 5.1:

- Rainfall space-time characteristics and forecasting
  The first research area is on space-time characteristics of rainfall and very short-term (several hours ahead) forecasting of rainfall. The multi-cascade space-time rainfall model has been developed and its parameters are being calibrated against radar data from locations across Australia.

  The outcome from this research will be software that will allow users to generate stochastic realisations of spatial and temporal rainfall characteristics from the mean rainfall from an area.

  The rainfall nowcasting (short-term forecasting) model, S_PROG, which has been tested with other models over the Sydney Olympic Games and beyond (see December 2000 and April 2000 *Catchword*s), is now being improved.

- Numerical weather prediction models
  The second research area will attempt to improve the surface hydrology representations in the Bureau's numerical weather prediction models (see November 2000 *Catchword*). This research is carried out jointly with Project 1.2 (Scaling procedures to support process-based modelling at large scales) and will involve soil moisture and other data monitoring in the Murrumbidgee River Basin. Preliminary sensitivity analyses and assessment of the weather variables (mainly temperature and rainfall) as forecast by the numerical weather prediction models, have been carried out by the Bureau of Meteorology. A research fellow (for research study) and a research assistant (for data monitoring) were appointed early this year, and the research should now progress rapidly.

- Stochastic downscaling techniques and models
  The third research area covers the stochastic downscaling of climate model simulations. The objective is to develop models that can estimate local scale weather variables (in particular rainfall) from large scale atmospheric variables (for example, mean sea level pressure) (see August 2000 *Catchword*). The project is currently developing statistical downscaling models for rainfall in the Murrumbidgee River Basin.

- Seasonal forecasting of streamflow

  The fourth research area is on the seasonal forecasting of streamflow. Research on the teleconnection between runoff, rainfall and El Nino-Southern Oscillation (ENSO)indicators using global runoff data and extended Australian runoff is almost completed. A paper will be written in the next few months summarising the potential for forecasting streamflow from ENSO and from runoff serial correlation for various parts of Australia at different times of the year. A non-parametric model for forecasting seasonal streamflow (see May 2000 and June 2000 *Catchword*s) has also been developed and is now further tested using data across Australia.

Project 5.2 National data bank of stochastic climate and streamflow models

- Stochastic models for rainfall and streamflow
  Project 5.2 deals with developing stochastic models for rainfall and streamflow and other climatic variables over a range of time and space scales.

  During last year we initially concentrated on specifying the range of variables to be considered over the three-year project, and on comparing at an annual time scale models that can be used to stochastically generate rainfall.

- Reproducing aspects of time series – model selected
  It is important that the models adopted are able to reproduce the quasi-periodicity that is often seen in climate and hydrologic time series. To this end we have been running trials of the Hidden State Markov (HSM) model of Mark Thyer and George Kuczera of the University of Newcastle. The HSM model has been designed to identify the runs of wet and dry years and estimate the appropriate model parameters.

- Model comparisons
  We have compared the results of this model with those obtained from the classical Lag One Markov model developed in the early sixties which has been the work-horse for hydrologists doing numerical stochastic simulation during the past three decades. The comparison has been carried out for 20 stations in Victoria and we have found that it is unnecessary to use the HSM here. The comparison is being extended to cover 40 sites across Australia and it is planned to have preliminary results available in March this year.

Tom McMahon
Tel: (03) 8344 6641
Email: t.mcmahon@civag.unimelb.edu.au

Francis Chiew
Tel: (03) 8344 6644
Email: f.chiew@civag.unimelb.edu.au

NEW CRC TECHNICAL REPORT

STOCHASTIC GENERATION OF CLIMATE DATA: A REVIEW

by
Ratnasingham Srikanthan
Tom McMahon

Report 00/16

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

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

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

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

27-29 August 2001

Hilton Hotel
Elizabeth Street
Brisbane

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

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

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

PLANNING TO ATTEND, SUBMIT A PAPER OR A POSTER?

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

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

PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Ian Rutherfurd

This article is a general summary of some of the recent developments in some of the evaluation projects being completed in the River Restoration Program. More details are expected in future *Catchword*s.

Project 6.2: Yarra restoration project

- Main aims

  The Project Agreement for this study is ready for signing. The project is aimed at preparing a hypothetical rehabilitation plan for a large Melbourne Water urban stream, and using models to evaluate whether the targets of the project can be achieved. Help with targets will come from the second part of the project, which will use flood detention basins to test whether returning more natural flow regimes to an urban stream leads to sustainable biological communities. This project is being completed in association with Program 4 (Urban Stormwater Quality), Melbourne Water, and Peter Breen's group at the CRC for Freshwater Ecology (CRCFE).

- Project leader

  An exciting development in this project is the arrival of Dr Tony Ladson as project leader. After an illustrious career as a river engineer, completing his PhD, and preparing the famous Index of Stream Condition for the Victorian government, Tony has now joined us as a Research Fellow in the School of Anthropology, Geography and Environmental Studies at the University of Melbourne. His email address is t.ladson@eng.unimelb.edu.au.

Project 6.3: Granite Creeks restoration experiment

- Collaboration on habitat restoration

  In close collaboration with Sam Lake's group at the Cooperative Research Centre for Freshwater Ecology, we are exploring the physical and biological response of sand-slugged streams to habitat restoration. Earlier work has demonstrated that the absence of large woody debris limits the abundance of bugs and fish in the typical sandy streams of the Granite Creeks system. So, with the help of the Goulburn Broken Catchment Management Authority (GBCMA), we are going to place artificial wood structures into 18 experimental sites. In Project 6.3 we will be investigating the physical changes that occur as a result of the structures: particularly bed scour and substrate changes. We will be testing a sand scour model developed by Nick Marsh as part of his PhD.

- Field sites

  All field sites have been selected for the experiment, and detailed surveys of each site (carried out by summer students Sam Bayley, Elisa Howes, Lauren Sheather, and Phillip Birtles) will precede installation of the red-gum sleeper structures in March. The structures will be built and installed by the GBCMA. The CRCFE have been steadily surveying bugs and fish at the sites. An interesting innovation in our monitoring is the development of a continuous bed level monitoring device using a pressure transducer and data logger. This device is being trialled at present by Mike Stewardson and summer student Nada Dashlooty. For more information on this project contact me on idruth@unimelb.edu.au.

Project 6.4: Evaluation of riparian revegetation in a SE Queensland catchment

- Whole-of-catchment

  As part of the SE Queensland Regional Water Quality Strategy we are evaluating a whole-of-catchment riparian revegetation project on Echidna Creek north of Brisbane. The ultimate aim of the work is to investigate options for controlling pollution of Moreton Bay. Nick Marsh (now a part-time research fellow based at Griffith University, as well as a PhD student) is managing the project under the direction of Project Leader Professor Stuart Bunn.

- Landholder assistance

  With the close assistance of all of the landholders in the Echidna Creek catchment (about 5 km^2), we plan to revegetate all of the riparian zone in the catchment. We will then monitor changes in water quality and other variables over several years.

- Sampling sites

  So far, sampling locations have been identified and nine data loggers have been installed: four on Echidna Ck (main study site) and one on each of two negative controls and one positive control streams. Loggers have been downloaded after their first month of operation and are all working well. We are recording suspended sediment by way of turbidity (two sites), discharge (five sites) and temperature (seven sites). The catchment is also being surveyed by QDNR. For more information, please contact Nick Marsh on nick.marsh@mailbox.gu.edu.au.

Ian Rutherfurd
Tel:(03) 8344 7123
Email: idruth@unimelb.edu.au

COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

The Flow on Effect – February 2001

Here are updates of some of our main communication activities.

Stochastic Generation of Climate Data: A Review - [An Apology]

In the December *Catchword*, I announced the report 'Stochastic Generation of Climate Data: A Review' by Ratnasingham Srikanthan and Tom McMahon (CRC Report 00/16) would be available before Christmas. Unfortunately there were some problems in the printing process and I apologise that it wasn't completed on time. I can safely say now, however, that this document is available.

The report reviews the state of research and practice in the stochastic generation of annual, monthly and daily climate data. The review forms part of the CRC's Climate Variability Research Program led by Tom McMahon at The University of Melbourne. Copies are available from the Centre Office (see below).

Nitrogen and Carbon Dynamics in Riparian Buffer Zones

Project 2.5, 'Nitrogen and Carbon Dynamics in Riparian Buffer Zones' is led by Dr Heather Hunter at the Department of Natural Resources in Queensland and is jointly supported by the Coastal CRC. The project aims to identify key factors influencing nitrogen and carbon dynamics in riparian zones and to determine the most effective riparian management options for minimising stream loadings of nitrogen.

A project sheet briefly describing the research and expected outcomes (part of the series describing all of our research projects) has recently been published and is available from the Virginia at the Centre Office. A pdf (Adobe Acrobat) version of the project sheet is also available at www.catchment.crc.org.au/landuseimpacts

Third Australian Stream Management Conference

The CRC for Catchment Hydrology is pleased to be a principal sponsor of the Third Australian Stream Management Conference to be held during 27-29 August 2001 in Brisbane, Australia.

The theme of the conference is 'The Value of Healthy Streams', providing a focus on the technical aspects of the following major themes:

- Ecosystem services - how do we quantify the values that healthy riverine ecosystems provide to humans (water quality, flood mitigation, sustainable fishery resources, stable bed and banks, etc) and to other ecosystems (on floodplains, in estuaries, etc)?
- Hydrological connectivity – how do we value the important linkages between the various hydrologic elements (streams, floodplains, estuaries and ground water) and what role do these connections play in regard to stream health?
- Bio-physical integration – how are the physical and biological aspects of stream systems inter-connected and how is the connection reflected in our planning and action?
- Tools and techniques – what are the latest developments in science that will assist us to better plan and manage our stream systems in a cost effective way

For further information about the conference visit www.catchment.crc.org.au/streamconference or contact

Mr John Amprimo
Conference Convenor
Department of Natural Resources
GPO Box 2454
Brisbane Qld 4001
Ph (07) 3224 7668
Fax: (07) 3224 8359
stream.conference@dnr.qld.gov.au

Updated Publications List

Enclosed with this *Catchword* is the January to March copy of our Publications List. The list includes the entire series of Salinity Disposal Basin reports published last year (see later) as well as other recent publications. Copies can be downloaded from the website (click on *Catchword*) and printed copies are available from the Centre Office.

Special CRC Feature in the Current Edition of Water

The January 2001 edition of the Australian Water Association journal 'Water' features a number of articles by CRC researchers. The CRC's contributions are aimed at assisting land and water managers and demonstrating the applications of our research. Authors and titles include Jacki Croke (Managing sediment movement and sources in forests), Francis Chiew (Seasonal Streamflow Forecast and Water Resources Management), John Fein (Postgraduate Education in the CRC for Catchment Hydrology), Ian Rutherfurd (Planning for Stream Rehabilitation: Some help in turning the tide) and John Tisdell (The Evolution of Water Management in Australia).

Salinity Disposal Basins

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

The final report 'Guidelines for Basin Use' by Ian Jolly, Evan Christen, Mat Gilfedder, Fred Leaney, Bill Trewhella and Glen Walker is now available (100pp+). This report is the culmination of three years research into developing generic guidelines for the use of local-scale salt disposal basins. A 'Guidelines Summary' (32pp) is also available for those who want a shorter reference.

CRC PROJECT SHEETS

Printed versions of the CRC project sheets (two page documents describing the key elements of research projects in CRC Programs except River Restoration and Communication and Adoption) are now available from the Centre Office.

There are 14 project sheets in total, and each gives details of research objectives, expected outcomes, target problems, key tasks, links, staff involved and contacts for that CRC project. They are an excellent way to quickly familiarise yourself with the nature and extent of our research program.

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

These sheets are also available for downloading from our website.

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

WHAT'S HAPPENING WHEN?

FIND OUT ABOUT CRC EVENTS BY EMAIL

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

You can register to receive this information on line at www.catchment.crc.org.au/subscribe

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

Reports from this series are covering key issues in the use of salinity disposal basins are now available for downloading as pdf files from the CRC website at the address;

www.catchment.crc.org.au/disposalbasins

Printed and bound copies of the complete series and a CD-ROM containing the set of fifteen reports as Adobe Acrobat files are also available from the Centre Office for $27.50 (inc. GST) each.

CRC Centre Office contact details
PO Box 60
Department of Civil Engineering
Monash University, Vic 3800
tel 03 9905 2704
fax 03 9905 5033
email virginia.verrelli@eng.monash.edu.au

David Perry
Tel: 03 9905 9600
email: david.perry@eng.monash.edu.au

POSTGRADUATES AND THEIR PROJECTS

Our postgraduate for February is:

Dominic Blackham

An Englishman Abroad

As one of the few Poms in the CRC for Catchment Hydrology, I should probably explain a bit about who I am. I'm currently working on my PhD within the "Environmental Flows Project" (Project 6.7: Developing an environmental flow methodology: a trail on the Campaspe River) of the River Restoration Program, run by Mike Stewardson and Ian Rutherfurd. Mike provided an overview of the Environmental Flows Project in the August 2000 issue of *Catchword*.

Coming to Australia

My connection with the CRC dates back to 1997, when, as a fresh graduate, I spent three months working as a vacation student with Ian Rutherfurd at Monash University. I spent my time aiding the authors of the Stream Rehabilitation Manual, drawing together information on the secondary impacts of rehabilitation measures, primarily increased flood and erosion risk.

Consulting - Bad For Your Health?

On my return to the UK, I joined WS Atkins, one of the largest engineering consultancies in Europe. During the three years I spent with Atkins in London, I worked on a variety of water environment projects, ranging from assessing the impacts on macroinvertebrates of increased abstraction from lowland rivers in Norfolk, to modelling the water distribution system for the whole of Greater London. In that time, I quickly developed the ability to have a go at anything, which proved to be an essential skill. I enjoyed (almost) every minute of my time with Atkins, but after three years I decided it was time to move on.

Back To School

Much to the bemusement of my friends, happily ensconced in their careers as bankers, management consultants and city slickers, I decided to return to the world of study. Having maintained intermittent contact with Ian, I decided to investigate the possibility of undertaking a PhD with him in Melbourne. I hoped that my academic and employment record would be sufficient to secure me a place in the Australian university system, but it proved to be slightly more problematic than I thought. However, having overcome the cultural (and other) differences, I was accepted into The University of Melbourne as an overseas student in September 2000.

Return To The Colonies

Although there is an ongoing internal debate about the funding of innovation in Australia, much of the work being conducted in Australia ranks alongside the best in the world. Research in fluvial geomorphology and river management is one of those premier areas. I've not quite worked out why that is, but I suspect that it is something to do with the state of the local streams (often knackered), and the amount of money being spent on fixing them (relatively large). Understanding the processes that shape river channels and ways in which those processes can be managed is an important part of research into, and management of, Australian streams.

Rule Britannia

In contrast, the UK Environment Agency (the body responsible for the management of British rivers), appears to place little emphasis on geomorphology, preferring to concentrate on the management of water quality. This attitude is slowly changing, but is hindered by a general lack of expertise in the area, both in the Environment Agency and consulting firms. The insight, skills and experience that will flow from my PhD will I hope allow me to make a difference in the way that geomorphology is applied to river management in the UK (provided I'm not tempted to stay in Melbourne by the wide range of diverting activities!).

River flows and channel shape

My project is focussing on the relationship between the amount of water flowing in a river, and the form that the river takes. There is a large body of knowledge on the flows that are responsible for forming the main channel, which is commonly thought to be the discharge that just fills the channel without spilling onto the floodplain (ie. the bankfull discharge). However, little is known about the flows that are critical for the formation of other features, such as in-channel bars and benches. These features are important from an ecological point of view, as they provide a geomorphological 'template' upon which the ecology of the stream develops. A greater understanding of the flows that are important in the formation of these features will fill a clear gap in the current geomorphological knowledge base.

Some key questions

At this early stage of the project, the key questions that I'm hoping to answer are:

- Which features are common throughout a length of stream (if any)?
- Do these common features share the same frequency of inundation?
- Are the features inundated for the same amount of time?

Hopefully, the outcome of this work will improve our understanding of the way rivers form. In addition, it may enable geomorphologists working on flow management studies of all kinds to provide greater insight when asked questions such as, 'how much water do we need to put down this river to maintain/promote the development of point bars?'

Dominic Blackham
Tel: (03) 8344 3947
Email: d.blackham@geography.unimelb.edu.au

WANT TO KNOW WHAT'S GOING ON?

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

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

LOOK UNDER 'EVENTS' ON OUR WEBSITE.

CRC ANNUAL REPORT ON-LINE

If you would like to learn more about the CRC for Catchment Hydrology's research and support programs, download a copy of our 1999-2000 Annual Report. The Report is available as a pdf and can be easily accessed from our home page.

www.catchment.crc.org.au

CRC PROFILE

Report by Rick Wootton

I would guess that amongst CRC people, I have had the longest academic association with Monash University and associated amalgamated Institutes. Some would suggest in-breeding having attended the then Caulfield Technical College (Technical Secondary School) as a year 7 student (1958), and staying to complete a Diploma of Civil Engineering at the renamed Caulfield Institute of Technology (CIT). I continued my education as a "blocko" at Melbourne University completing a B E (Civil).

My working life began with the State Rivers and Water Supply Commission (Vic) as an assistant engineer in country irrigation regions, initially at Cohuna and then at Pyramid Hill in a difficult drought period (1968/69).

In 1970 I returned to Melbourne to complete teacher training (TTTC) at Hawthorn State College with the practical teaching component back at CIT. In the following year I began the first of 30 years of lecturing in Hydraulics and Hydrology with my employee changing names (amalgamations) from CIT to Chisholm Institute to Monash University.

In 1976 I completed a M Eng Sc at Monash supervised by Russell Mein in Urban Hydrologic Modelling, and 25 years later find myself again working on urban hydrologic modelling (Program 4: Urban Stormwater Quality) with Russell now the Director of the CRC. The difference being that in 1976 the only interest was in the flooding problems induced by urbanisation whereas today the interest is much broader, for example, Water Sensitive Urban Design (WSUD) and water quality considerations for downstream receiving waters.

In terms of my CRC activities, these have developed largely as a result of Tony Wong joining the academic team at the then Chisholm Institute and the resultant sharing of the teaching duties in the water engineering field. An approach by a local company to review and test a proprietary design for Gross Pollutant Traps kindled an interest in improving the quality of urban runoff, and a broadening of this interest by staff and postgraduate students (particularly from the Caulfield campus) has developed into the aims and aspirations of Program 4 of the current CRC.

Apart from a family and sporting activities I have an enchantment with orchid culture. In particular, the propagation and culture of Australian orchids, which I trust will continue into the future. Orchids provide an excellent example of the adverse effects of our activities on the native flora and fauna, with many species facing extinction. At this stage I cannot see any means of avoiding the land disturbance activities that are having such an adverse effect on many of our terrestrial orchids. I am also very disturbed by the way desirable orchid species are ruthlessly collected and sold for profit.

At this point the effects of man have not been as devastating on the receiving waters and oceans surrounding Australia (I realise that commercial fishing and whaling are serious problems). Degradation of our waterways and receiving waters has been severe locally but I believe the community is becoming aware of these problems and is prepared to find solutions. With the appropriate research programs and the even more important technology transfer to our urban communities, the door may be still open to reach a balance between development and our waterway environments.

Rick Wootton
Tel: (03) 9905 4958
Email: rick.wootton@eng.monash.edu.au

WHERE ARE THEY NOW?

Report by Paul Feikema

I guess I am one of a group of graduates of the CRC who remain in research. I started as a research scientist in February 1999 with the Centre for Forest Tree Research (CFTT), a business unit within the Department of Natural Resources and Environment (DNRE) that undertakes forestry research both locally and internationally.

Like many others who have done so, and with the words of Russell Mein still echoing in my ears, I can attest that writing up while working full-time is not recommended in the slightest. This was made even more difficult for me while settling into a new job, renovating a house, and preparing for the birth of our first son. While I had promised myself that I would submit before Tom was born, lucky for me, Tom was (and still is) an angel and I managed to submit three months later in March 2000.

I am also fortunate to work in a research organisation that understands and values postgraduate research - and the director at the time, David Flinn, encouraged me to take some time to assist me in completing my thesis.

The work at CFTT has introduced me to more traditional as well as new forestry research. I currently manage a project to develop climate and soil based information for predicting the growth of Eucalyptus globulus (blue gum) and E. nitens (shining gum) in farm forestry systems in south-eastern Australia.

We have already set up about 210 permanent sampling plots (PSP's) in plantations on ex-agricultural land throughout north-eastern Victoria, central Victoria, south-western Victoria and south-eastern South Australia. We plan to establish more plots to give a total of about 250. The project involves measuring tree growth and nutrition (every two years), and climate and soil attributes, and we will eventually use this information to predict the productivity of these plantations under the variety of conditions in which they grow. We are currently making detailed soil profile descriptions at each plot, by digging soil pits down to 4 m. It is interesting to see 2.5 year old blue gums with roots down to 4 m. I am learning a lot about soils and tree growth I never knew before!

While we are not directly measuring any hydrological attributes in this project, we assume that one of the limitations to growth in time will be water. Therefore, the climate, together with the moisture holding capacity of the root zone (eg. soil texture, porosity, impeding layers) and the presence of fresh groundwater, will certainly play a major part in plantation growth over a full rotation. At present, the trees are between 1.5 and 3.5 years old - too early to detect any trends yet. We intend to monitor these trees until they are harvested at 10-12 years of age. One of the aims of this project is to provide data for work by Jim Morris (CFTT) to parameterise and validate the 3PG forest growth model for E. globulus and E. nitens in south-eastern Australia.

The project involves collaboration with a number of blue gum prospectus companies in south-western Victoria, and with private landholders in north-eastern Victoria. The project has established ties with NRE staff in north-eastern and south-western Victoria, as well as with staff from the State Chemistry Laboratories and from the Centre for Land Protection Research.

Like many other "post-postgrads", I have found my new job a welcome relief. Instead of making detailed measurements in a 21 year old stand of unirrigated eucalypts at Kyabram that were struggling to survive, let alone put on much growth, I am now out and about measuring a variety of attributes across a wide geographical area in which the trees are growing up to 4 metres per year in some cases.

I also play a small part in other projects, including thinning and fertiliser trials in Gippsland, and biomass trials near Shepparton.

With work, a 12 month old son, and a house that still requires my dedicated attention, I rarely have time to reflect. Nonetheless, certainly I haven't forgotten the supportive and stimulating environment and the good times I had while with the CRC.

Paul Feikema
Tel: (03) 9450 8692
Email: paul.feikema@nre.vic.gov.au

LINKS TO KEY HYDROLOGY WEBSITES

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

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

www.catchment.crc.org.au

If undelivered return to:

Department of Civil Engineering
PO Box 60
Monash University
Vic 3800

Surface Mail

Postage Paid Australia

Print Post Approved
PP338685/00026

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

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

Associates: SA Water • State Forests of NSW

CENTRE OFFICE:
CRC for Catchment Hydrology
Department of Civil Engineering
PO Box 60
Monash University, Vic 3800
Telephone: +61 3 9905 2704
Facsimile +61 3 9905 5033

http://www.catchment.crc.org.au