



International Association of Hydrogeologists

AUSTRALIAN NATIONAL CHAPTER

NEWSLETTER

Vol. 9 No. 1

JUNE 1992

BLUE-GREEN ALGAE AND GROUNDWATER

President Assoc. Prof. M. Knight CGMH UNSW P.O. Box 1 Kensington Sydney 2033 Ph(02)697 4275 Fax(02)662 1923	Vice President Mr. D. Woolley 3 Barwon Ave. Turrumurra NSW 2074 Ph(02)895 7557	Secretary Dr. R. Carr Lawson & Treloar Pty. Ltd. P.O. Box 799 North Sydney NSW 2060 Ph(02)922 2288 Fax(02)922 1195	Treasurer Mr. J. Ross DWR 10 Valentine Ave. P.O. Box 3720 Parramatta NSW 2124 Ph(02)895 7562 Fax(02)895 7281	State Liason Members WA Mr. D.P. Com- mander SA Mr. S. Barnett VIC Mr. R. Lakey QLD Mr. B. Pearce NSW Mr. G. Gates ACT Dr. M. Habermehl NT Ms. D. Karp
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Editor: Dr. G. Pantelis, Ansto, PMB 1, MENAJ, NSW 2234; Ph. (02) 717 3056; Fax. (02) 717 9260

IAH NEWSLETTER VOL. 9 NO.1, JUNE 1992

FROM THE PRESIDENT

It has been encouraging to see the launch recently of the first edition of the *Journal of Applied Hydrology*. The Editor, Professor Eugene Simpson advises me that all IAH members should eventually receive a free copy. If you haven't had one through the mail, it may be worth contacting him (details of his address in our IAH Newsletter 8(2), 1991).

In the last Newsletter I mentioned that we are keen to encourage research publications such as in the *Journal of Applied Hydrology*. The instructions to authors are included in this newsletter as they were accidentally omitted from the last issue. There is still a "Best Publication" prize in the offering. The inaugural annual publication award (\$250 for best paper) still hasn't attracted any submissions. The prize for the period ending June 30, 1992 is closing fast. Now is the time to submit, or your entry will be in the barrel for the 92/93 selection.

Whilst on the publication track, it could be very helpful to members if we could publish lists of recent Journal article titles (including abstracts where appropriate), report titles, theses etc. So if you are interested in having your colleagues know what you or your organisations are reporting, please send the data to the editor. Best to provide: Title, Author, Organisation, Abstract (may or may not be published depending on space).

The importance of groundwater received a boost during 1991/92 as a consequence of the Blue Green Algae Darling River Media Promotion. There are substantial groundwater issues linked to the algae problem and at a recent IAH NSW Group meeting, John Verhoeven gave an excellent overview. John is the Department of Water Resources (DWR, NSW) Chairman of the Blue Green Algae Taskforce that has provided a very informative report on the Algae issue. The report is on sale through DWR. The algae matter is another illustration of how the Groundwater Profession is diversifying at a rapid rate, especially in its application to environmental problems.

In conclusion, I wish to congratulate Peter Dalhouse and the organizer of The Australian Geological Convention held at Ballarat in January this year. From all reports a good time was had by one and all, with some excellent groundwater papers being presented. The 1994 IAH Congress in Adelaide continues to be organized under Peter Dillon's able team. Do start planning to attend and if possible present a paper.

NOTES FROM THE NATIONAL SECRETARY

Old Proceedings

The National Executive has inherited 32 sets of 1986 International Proceedings and would be delighted if any member would like to receive a set. The package includes:

- Volume No. 2 - Hydrology of Limestone Terranes.
- Volume No. 5 - Impact of Agricultural Activities on Ground Water.
- Volume No. 7 - Hydrogeological Mapping in Asia and the Pacific Region.
- Bulletin No 23 - 1983-1985

1986 List of Members

The package contains all of the above. If you want one, you receive the whole package.

Please fax Robert Carr on (02) 922 1195 with your postal address if you are interested.

IAH Membership

Members wishing to show their membership of IAH on business cards or correspondence may do so by using the abbreviation MIAH, (ie. Frederick Aquifer, B.Sc, MIAH).

UNITED NATIONS GROUNDWATER SOFTWARE

The United Nations Department of Technical Cooperation for Development has developed a groundwater software package with modules for dealing with chemistry, pumping tests, bore logs, and groundwater models. A copy of the software and the manuals has been sent to Don Woolley, with a request that it be made available to colleagues on request.

The NSW Department of Water Resources has prepared some copies of the manual and will provide a copy, together with the software which comes on three floppy discs, at a cost of \$20 (to partially cover the cost of copying the manual and of the discs). Please contact either Don (02 8957557), Mike Williams (02 8957529) or John Ross (02 8957562), or write to one of them care DWR at PO Box 3720, Parramatta 2124. We would appreciate comments on the package, from anyone who has used it, or who obtains a copy from us.

CONFERENCES

MURRAY-DARLING BASIN GROUNDWATER WORKSHOP 3

This is the third in a series of biennial workshops to present and discuss recent hydrogeology work carried out in the Murray-Darling Basin. Out of these discussions, greater co-ordination of research effort and the distillation of priorities for future work are aimed for. It is to be held in the Chaffey Theatre, Renmark from 27-29 October 1991.

Papers are sought in the following themes:

- salt disposal
- recharge control
- salinity mitigation (drainage and interception)
- modelling
- environmental consequences of groundwater salinity
- recent hydrogeological investigations
- contamination
- future policy directions

For further information, contact:

Steve Barnett
SA Dept of Mines and Energy
P O Box 151
EASTWOOD SA 5063

Rob Newman
EWS Dept
GPO Box 1751
ADELAIDE SA 5001

Glen Walker
CSIRO Div of Water Resources
Private Bag 2
GLEN OSMOND SA 5064

Ph (08) 274 7583

Ph (08) 226 2510

Ph (08) 274 9385

GEOLOGICAL SOCIETY of AUSTRALIA

ENVIRONMENTAL, ENGINEERING AND HYDROGEOLOGY SPECIALIST GROUP

Formerly known as the Engineering Geology Specialist Group

Even though the vowed aims of the EGSG was to promote Engineering Geology in its widest sense (including environmental and hydrogeology, coastal processes etc), support for the group remained relatively low. This is possibly because of a literal (littoral) interpretation of the group's title. This was discussed at the General Meeting at IAGC and a resolution changing the name to that above was supported.

All geologists working in the fields of environmental and urban geology, waste disposal, coastal processes, quarries, hydrogeology etc are encouraged to join the EEHSG to drag the GSA away from its academic bias, and even submit papers for a Case Studies Volume which is proposed to be published on a regular basis. The Executive Committee has been transferred to Perth and any enquiries, articles for newsletters etc should be addressed to:

Hon Secretary: Mr Ron Colman
P O Box 269
INGLEWOOD WA 6052

Ph (09) 470 2233
Fax (09)470 2234

State Reps: NSW G McNalley
QLD G Eades
ACT M Habermahl
SA P Smith
VIC J Brumley
TAS F Baynes

NATIONAL GROUNDWATER CENTRE MOVES TO UNIVERSITY OF TECHNOLOGY SYDNEY

August 1, 1992 sees the commencement of the "National Centre for Groundwater Management" at the University of Technology Sydney (UTS). This represents a move to UTS of the National Centre of Water Research Concentration in groundwater management and hydrogeology, begun originally at University of NSW under the auspices of The Australian Water Research Advisory Council (AWRAC).

At its Board meeting on June 5, 1992, the Land and Water Resources Research and Development Corporation (LWRRDC) that replaced AWRAC, decided to recognise The National Centre at UTS.

Core staff of the UTS Centre include:

Associate Professor Michael J. Knight *Director*
Dr William A. Milne-Home *Senior Lecturer in Hydrogeology*
Noel Merrick *Senior Lecturer in Groundwater Modelling and Geophysics*
Robert G. McLaughlan *Research Fellow in Contaminant Hydrogeology*
Ms Romy Peters *Administrative Assistant*

Other staff will be added as projects develop.

Organizationally the National Centre will be an independent group co-operating with both the Engineering and Science Faculties.

The mission of the Centre is to provide the Water Industry and Profession with a high quality service in the three areas:

*Training,
Research and
Consultancy*

Training:

The following postgraduate groundwater programs are currently being established in Faculties of Engineering and Science at UTS: PhD, MSc (Research), ME (Research), Master of Applied Science and ME in Hydrogeology and Groundwater Management (coursework), Graduate Diplomas and other specialized short courses. It will be possible to enter the programs from Science, Engineering or other appropriate backgrounds. The University of Technology Sydney has strong, existing training programs in Surface and Waste Water Engineering, Geology and Toxicology and Centre staff will be interacting closely with these.

Research:

Centre staff plan to continue researching;

- The development of groundwater models and critically reviewing existing flow and contaminant transport models.
- Contaminated sites and waste management - groundwater interactions.
- Critical aspects of salinity management.

- Groundwater resource management and development optimization.
- Groundwater geophysics.
- Biofouling and borehole deterioration management.

Consultancy:

Consultancies will continue to emphasise specialized review rates. Some major projects in progress currently include:

- Review/Expert Witness, Commission of Enquiry into Lucas Heights Regional Waste Disposal Depot Extension.
- Proposed Olympic Village site, Newington, Sydney Review for Department of Defence.
- ICI contaminated land and groundwater at Botany, Sydney.

Facilities:

The Centre will have access to a range of well established laboratories, hydraulics, public health, chemical, geological, computing and toxicological.

Location:

The Centre will be located at The Broadway Campus, Sydney near Central Railway Station.

Enquiries may be directed to:

National Centre for Groundwater Management
University of Technology Sydney
C/- Faculty of Engineering
P O Box 123 Broadway
Sydney 2007, New South Wales, Australia.

Contact: Temporary contacts up to August 1, 1992 may be made:

Phone: (02) 330 2599 (W)
Fax: (02) 330 2611

NATIONAL COMMITTEE NEWS

TREASURER'S ANNUAL REPORT

The 1991 year has now past for the Association. Financially, the Australian Chapter is in sound condition with over \$16000 in the bank as at the 31st of December 1991. This amount covers most member's 1991 subscriptions. Thankyou to everyone for paying their 1991 subs so promptly. In March this year an amount of \$9249 (11495DM - exchange rate DM 1.24) representing 209 subscriptions was remitted to Germany to cover the 1991 memberships. At the time of writing this newsletter, the Australian Chapter had:

- * 222 fully paid up members for 1991 and 1992
- * 17 members in arrears for 1 year
- * 8 members in arrears for more than 1 year

New Members

The number of new members continues to increase. Thanks to all those actively signing up new members and promoting IAH. The following new members are welcomed :

Mr S Guba (Vic)	Mr T Calvert (NSW)
Mr W Huxley (Qld)	Mr R Wallis (WA)
Mr S Doyle (WA)	Mr H Middlemis (UK)
Ms P Tyson (NT)	Mr S Evans (SA)
Mr P Evans (Qld)	Mr Z Berhanu (NSW)
Dr C Otto (WA)	Mr N Somaratne (NSW)
Mr K Bogoda (NSW)	Mr J Bradd (NSW)
Mr C Van Toorn (NSW)	Mr M Nandan (QLD)
Dr A Rathur (WA)	Mr R Panasiewicz (WA)
Mr P Howe (WA)	Ms J McNamara (WA)

(NOTE. Those who joined after 1 July 1991 are financial members for 1992 as this is the first year they will receive publications from overseas).

Membership now totals 247 (current financial members plus those in arrears for 1989, 1990 and 1991). Distribution on a State by State basis is WA(76), NSW(48), VIC(47), QLD(33), NT(14), SA(12), ACT(7), TAS(0) and OVERSEAS(10). There are currently 289 people on the National Committee's Newsletter circulation list.

Financial Statement

The Australian Chapter's Statement of Income and Expenditure for 1991 is shown below.

STATEMENT OF INCOME AND EXPENDITURE FOR YEAR ENDED 31.12.91
(SUBSCRIPTION YEAR 1991)

DOLLARS (\$)

INCOME

Membership Subscriptions		
1989 (in arrears)	- 1	55.00
1990 (in arrears)	- 26	1430.00
1991 (at \$55)	- 21	1155.00
1991 (at \$60)	- 129	7740.00
1992 (in advance at \$55)	- 5	275.00
1992 (in advance at \$60)	- 6	360.00
Bank Interest		
Cheque Account		40.91
Savings Investment Account		654.98

TOTAL INCOME \$ 11710.89

LESS EXPENDITURE

Remittance of Subscriptions to Germany	7777.41
Reimbursement of Overpayments	55.00
IAH Newsletter Production	1048.27
Postage	781.00
Envelopes, Paper and Sundries	408.00
Cartage	125.66
Government Charges	16.28

TOTAL EXPENSES \$ 10211.62

NET SURPLUS FOR THE YEAR 1499.27
Add BALANCE FROM LAST YEAR 15211.17

ACCUMULATED FUNDS ON HAND (as at 31.12.91) \$ 16710.44

Represented by -
Cash at Bank - Savings Investment Account 14026.44
Cheque Account 2684.00

TOTAL \$ 16710.44

Honorary Treasurer

Date 23rd April '92

Auditor's Report

I have examined the Statement of Income and Expenditure for the year ended 31 December 1991. In my opinion, these financial statements are in agreement with the books and records maintained by the IAH - Australian Chapter.

Honorary Auditor

Date 29 April '92

1992 Subscriptions

The 1992 subscriptions are now due. The Executive has decided to retain the current membership fee at \$60 as the fee determined by the International body has remained the same and the National body's expenses are not expected to increase substantially during the coming year.

Members in Arrears

The following members are in arrears for the years shown. The treasurer would appreciate if fees (\$60 for 1991 and \$55 for 1990) could be forwarded as soon as possible.

In arrears for 1991 -

Blake, Brunner, Carney, Gates, Hall, Hatley, Hearne, Hoxley, Lane, Maltby, McAvan, McGowan, Moore, Phillips, Rivera, Vogwill.

In arrears for 1990 and 1991 -

Bleys, Grounds, Hailu, Helm, Ife, Lloyd (T), Tickell, Tuckson.

IAH membership rules state that memberships in arrears for more than two years will lapse. Hence the following members who have not paid since 1988 are deemed to have resigned -

Bell, Dyson, Love, Preston, Punthakey, Rowan.

Address Changes

Members are reminded to send any changes of address to me at the following address :

JB ROSS
IAH Treasurer Fax (02) 8915884
c/- Hydrogeology Unit
Dept. of Water Resources
PO Box 3720
PARRAMATTA. NSW. 2124

Please mark all correspondence "Personal".

IAH WESTERN AUSTRALIAN BRANCH NEWS

1991-2 Committee (elected at AGM 26.6.92)

Chairman	Greg Davis
Vice-chairman	Phil Commander
Secretary	John Waterhouse
Meetings secretary	Len Baddock
GSWA Subcommittee rep.	Phil Wharton

Meetings:

1991

- 26 June Terri Bulman: Campbell Environmental
In situ bioremediation - feasibility testing and field scale.
- 7 August Presentations on technical equipment:
Age developments: Downhole testing equipment
Wesdata (Jeff Smith): Downhole data logging
Mirco Riha: Bladder pumps
Alan Mann: Automatic chemical analyses
- 9 September Derek Hopkins: Water Authority WA
Water management of the Gngangara Mound - overview of policies and practice (Joint IEA)
- 4 November Lex Bastian: Chemistry Centre WA
Speleogenesis at Yanchep
Rauleigh Webb: Speleological Society
Water movement in caves in the Eucla Basin
- 4 December Claus Otto: (CSIRO)
Hydrogeological indicators and controls of soil deposits in the Upper Rhine Graben, France
- 1992
- 3 February John Waterhouse: AGC Woodward-Clyde
The Olympic Dam water supply
- 16 March Joseph Thierrin: (CSIRO)
The VLF-LF-Resistivity method: A rapid and portable geophysical tool for shallow hydrogeological investigations with case studies from Switzerland
- 6 April Munna Sharma: (CSIRO)
Impact of horticulture on water and nutrient fluxes to an unconfined aquifer.

RICHARD BARNES BURSARY

The Richard Barnes Bursary was set up to assist and encourage final year students to undertake a project in Hydrogeology. This year it has been awarded to Sara Cody of the University of Western Australia. Her project is entitled 'Electromagnetic techniques for groundwater quality monitoring'.

KIMBERLEY PIPELINE

In response to the Premier's announcement of \$3 million to be spent by the Kimberley Pipeline Management and Advisory Board, the Western Australian Committee of IAH sent the following letter which was published in the 'West Australian' on 26 March 1992:

LETTERS TO THE EDITOR

Kimberley water pipe plan a folly

IN ALLOCATING \$3 million to assess the feasibility of a Kimberley pipeline, the Government appears inconsistent in its approach to WA's water resources management.

It has preferred to shelve groundwater options by cutting back on funding for groundwater exploration and has chosen to ignore reports by its own departments and by the WA Water Resources Council.

There is no imminent water shortage for Perth.

Studies such as the one entitled "Planning future sources for Perth's water supply" conclude that sources nearer than Harvey are sufficient for current demand until at least the year 2010. The study, "Water for the 21st century", has stated that there are sufficient water resources in the South-West — both surface and groundwater — to meet foreseeable increases in demand at least until 2050.

Since those reports were pre-

pared, the Mines Department has also estimated the amount of fresh groundwater stored underground between Bunbury and Augusta to be the equivalent of 60 Lake Argyles, enough to supply Perth for hundreds of years.

The proposal to pipe water from the Kimberley to Perth is erroneously compared with the Goldfields scheme. C.Y. O'Connor's great achievement was to supply the people of the Goldfields with relatively cheap water.

It is not clear why today's taxpayer should be expected to fund studies aimed at supplying water at far greater cost than that from existing sources.

Three million dollars could be better spent on research and further exploratory drilling within the Perth Basin to better assess and manage existing water reserves. — G.B. DAVIS, chairman, WA branch, International Association of Hydrogeologists, Floreat.

A reply from the Minister of Water Resources to the WA Branch letter appeared in the 'West Australian' on 4 April 1992:

Geologists on wrong trail

IT IS misleading for the WA branch of the International Association of Hydrogeologists to say that the Augusta area's groundwater resources can supply Perth for hundreds of years ("Kimberley water pipe plan a folly". Letters, 26/3).

That could be achieved only if the resource was "mined", taking more than would be replaced by annual rains — a process with dire consequences for the environment.

I am advised by the WA Water Authority that the safe sustainable annual yield from the Augusta area's groundwater is less than a quarter of Perth's expected consumption at the year 2050.

LETTERS TO THE EDITOR

I am also told that the resource at its south-east corner runs under the D'Entrecasteaux National Park and that it is not new water as suggested — it was included in calculations for the 1988 report entitled "Water for the Twenty-First Century".

To say that options for groundwater have been shelved by cutting back on groundwater exploration is also misleading.

Where water is needed the drilling goes on.

For example, over the past five years the Government has

spent almost \$1 million drilling for water in the Nullagine area of the Pilbara with limited success, but funding for the exploration program continues.

It is predictable that the water drilling industry favours groundwater exploitation, but the Government has many community interests and industry groups to consider.

The independent Kimberley pipeline feasibility study will weigh up all of those interests, including those involving the environment and regional communities such as Nullagine. It will present a balanced assessment of the project's benefits to the people of WA for their judgment. — ERNIE BRIDGE, Minister for Water Resources.

IAH - QUEENSLAND DIVISION ACTIVITIES

IAH MEETINGS

At the December 1991 meeting, Dr Mal Cox, from Queensland University of Technology, gave an interesting talk about "Hydrogeology and Geothermal Systems". Mal drew on his extensive experience in Hawaii, Fiji and New Zealand.

In February, Dr Ted Loder from the University of New Hampshire presented "Nutrient Loading in Estuaries", with special references to his recent research in Queensland with Earthwatch.

At the April meeting, Colin Laing, one of the original Australian IAH members, spoke about "Mineral Waters and their Recent Exploitations". This proved to be informative, with several anecdotes of the history of mineral waters in Australia.

VICTORIAN VISIT

Robert Ellis, Hydrogeologist with the Water Resources Commission (and Queensland Division's Secretary Treasurer), attended the 11th Geological Convention, in Ballarat. He was a participant on the Murray Basin Hydrogeology Excursion, ably run and organised by Victorian IAH members, John Leonard and Richard Lakey. He also attended the "Current Techniques in Physical and Chemical Hydrogeology" run by Ron Nicholson and David Rudolph from Waterloo Centre for Groundwater Research in Ontario, Canada.

The Hydrogeology and Environmental Sections of the convention were well worth attending.

After the convention, Robert spent a week touring Western Victoria and South Australia, perusing the geology and hydrogeology of which he had previously heard, but not seen.

The whole trip was well worthwhile, particularly catching up on old and new IAH members.

CYPLUS

Yes, this stands for Cape York Peninsula Land Use Study, and is a Queensland/Australian Government project, aimed at scientific research in all fields in the far north of the State.

The Water Resources Commission and Bureau of Mineral Resources will be doing joint mapping, drilling, maintaining, etc, over a period of two years. One new hydrogeologist has been appointed on contract for the duration of the project.

NOTES FROM VICTORIA

WATER SECTOR REFORM CONTINUES AT A FAST PACE IN VICTORIA

The Office of Water Resources which was briefly relocated within the Department of Conservation and Environment was reinstated at the department of Water Resources under Minister Steve Crabb in January 1992.

A major review of the future management of the Rural Water Commission (the McDonald Review) was released in March 1992. The Minister for Water Resources in adopting the recommendations of this independent panel announced on 24 March 1992, that:

The Rural Water Commission is to be replaced by a new corporation (The Rural Water Corporation) on 1st July 1992. The Corporation will be outside the Public Service and outside the budget sector.

It will consist of:

- a small corporate centre with a Board of Directors to provide strategic direction and fiscal guidance;
- five regional water organisations each with its own Board of Management. These Boards will determine the level of services and progressively take up decision making responsibilities, including price setting.
- a water services organisation which will provide specialist services to the water industry on a commercial basis.

In addition two new regional water authorities have been established in north central Victoria. The Coliban Authority will take over the functions of the seven former water boards and the Coliban Water District of the Rural Water Commission. The Campaspe Authority amalgamates three former water boards.

The Minister is expected to release a water industry statement shortly which will include a 10 year action plan.

RECENT PUBLICATIONS AND REPORTS

A major publication, "Water Victoria: The Next 100 Years", is now available from the Department of Water Resources. This book is a very well illustrated, high quality publication, some 250 pages in length. It presents an historical, technical and economic description of surface water and groundwater development in Victoria.

The book addresses the future direction of water resources management in Victoria by evaluating a number of scenarios for future management against a long-term planning model. It is argued that the best scenario for Victoria involves developing a trade in water already harvested between irrigation, industrial and domestic users. It will serve as a useful planning tool for water resource planners in other States and countries.

A substantial technical report on, Groundwater Development Options and Environmental Impacts for the Barwon Downs Graben south west of the city of Geelong has recently been released by the Department of Water Resources. This document draws together the results of geological and hydrogeological investigations and studies undertaken in the area from the early 1960's.

The current work raises a number of important issues for integrated management and development of the total resource. In particular it is recognised that there is a requirement for resource planners and managers to evaluate and compare the long-term environmental impacts of comparable (in terms of capacity) surface water and groundwater developments during the analysis of options for future water supply augmentation. The report includes a major numerical modeling component.

PROJECTS OF NOTE

South Australian/Victorian Mallee Region Groundwater Study

An NRMS funded collaborative study, between the South Australian Department of Mines and Energy and the Victorian Department of Water Resources with input from a number of other agencies, is currently developing a numerical model for the Mallee and Wimmera regions of Victoria and South Australia. This model is one of several regional modeling projects being undertaken for the MDBC. The primary objectives are to:

- evaluate the future impact of salinity on the environment and Murray River;
- quantify groundwater resources in Mallee and Wimmera Regions;
- establish a regional framework for negotiations relating to the SA/VIC Border Zone Groundwater Sharing Agreement;
- provide a technical basis for specification of groundwater entitlements in Victoria.

The Department of Water Resources has a number of case studies in place to examine the issues involved in granting bulk water entitlements (BWE's) to multi functional regional water authorities under the recently proclaimed Water Act (1989). The groundwater case study is based in the Gippsland Region and is being carried out in collaboration with the Rural Water Commission.

PEOPLE ON THE MOVE

John Leonard and Phil Macumber are now both working in the Sultanate of Oman. John has joined Dames and Moore and Phil is with the Ministry of Water Resources and is responsible for the first serious groundwater study of a large remote area; - more on the adventures of Phil and John later.

David Ife is returning to Australia after a two to three year stint of overseas consulting; welcome home David.

Charles Lawrence has accepted a position with the University of Melbourne where he is coordinating an MSc. course in Hydrogeology and Environmental Science.

NEW SOUTH WALES NEWS

The Centre for Groundwater Management, and Hydrogeology is moving from the University of NSW at Kensington to University of Technology of Sydney at Broadway on 1st August 1992. With some staff remaining are at UNSW. It is hoped with this move that the teaching and research component of hydrogeology on the east coast of Australia will continue to expand.

The consulting sector continues to expand in NSW with all companies reporting growth particularly in the environmental areas.

In the state government sector more redundancies have been foreshadowed in a number of enterprises including the water sector.

However in the Department of Water Resources with funded work requirements increasing 3 additional long term consultants have been engaged in the last 6 months to assist.

They are:

- . Lucy Lytton (from Groundwater Technology and UNSW) preparing a hydrogeological map of the NSW section of the Darling Basin,
- . Medwan Kerwan (from Geol. Survey of Fiji) assisting with water management issues at Deniliquin; and,
- . Andrea Broughton (from UNSW) carrying out dryland salinisation studies at Gunnedah.

Other staff movements include:

- . Gabriel Salas has left Dubbo for a 2 year AIDAB funded project with the Geological Survey of Botswana. Gabriel who is fluent in French, German, Spanish (as well as English) and less fluent in Portuguese and Italian, hopes to learn Setswana (a local dialect); and,
- . Scott Lawson to the Leeton Office where he reports English is also spoken.

The NSW Chapter meeting program which has been so successful in previous years has been included in this report for interstate members and/or guests.

INTERNATIONAL ASSOCIATION OF HYDROGEOLOGISTS
(NSW CHAPTER)

The venue for the April and June meetings is:

Room 713
Applied Science Building
University of NSW

You will be advised of the venues for later meetings in June, 1992.

Time is 5:30 for 6 pm with meetings generally finished by 7 pm.

The meeting program for the remainder of 1992 is outlined below:

Date	Topic	Presenter	Affiliation
30th April	Blue-Green Algae - a groundwater perspective	John Verhoeven	DWR (NSW) Chairman of the Blue Green Algae Task Force
11th June	Environmental Auditing	Stan Sturges	GHD-CH2M Hill
14th August	Soil Erosion Modelling	Gary Wilgoose	University of Newcastle
22nd October	Application of Isotope and Geochemical Methods In Groundwaters	David Waite	ANSTO
3rd December	. National Groundwater Issues . IAH Christmas Party at Northern Suburbs Rugby Club	Jim Keary	Dept. of Water Resources (VIC) Manager, Water Planning

All Visitors are Welcome

Should you have any enquires with regard to the program or Christmas Party please contact either John Ross 895 7562 or Mike Williams 895 7529.

BLUE-GREEN ALGAE: A GROUNDWATER PERSPECTIVE (Presented to the NSW Chapter of IAQ on 30 April 1992)

T.J. Verhoeven
.. Manager Environment Branch
.. Department of Water Resources
.. Chairman NSW Blue-Green Algae Task
.. Force

1. INTRODUCTION

Eutrophication of our water resources is an increasing problem. In Australia, the first toxic algal bloom was noted in Lake Alexandrina (S.A.) in 1878. Toxic and non-toxic algal blooms have been reported in NSW each year for at least the past 20 years with increasing regularity on water storages, weir pools and stretches of rivers.

The problem was highlighted with the occurrence in the Darling-Barwon River System in November and December 1991 of the world's largest recorded riverine algal bloom, extending for 1000 km (Figure 1). The problem was brought dramatically close to Sydney with algal blooms in the Hawkesbury River in December 1991 and January 1992. During this same period 20 other waterways in NSW also had blooms at the extreme alert level, while blooms were reported in a further 15 waterways.

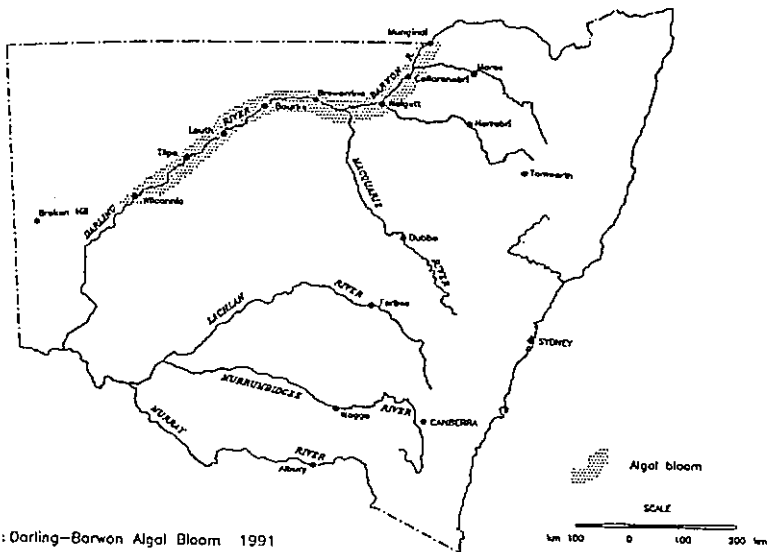


Figure 1: Darling-Barwon Algal Bloom 1991

While public attention on the blue-green algae problem focussed on our waterways, there is also an important groundwater perspective. This paper describes blue-green algae. From an examination of the factors that affect algal bloom development and of the impacts of blooms, the role of groundwater is determined (much of the information in this paper is drawn from Reference 1).

2. BLUE-GREEN ALGAE

Blue-green algae are primitive photosynthetic organisms found in many environments including inland waterways, estuaries and the sea. They are found as microscopic single cells, filaments or colonies, but when their numbers become excessive due to nutrient enrichment, free floating forms develop into visible blooms and scums (with counts approaching one million cells/mL and higher). Blue-green are in fact cyanobacteria.

When in low numbers blue-green algae are important in the aquatic biology of our waterways. However, their numbers can often rise to a level where their noxious properties can become disastrous to water resource users. They are unsightly, create an extremely unpleasant odour, and their toxins have been known to cause sickness in humans and death in livestock and pets.

The characteristics of blue-green algae and influencing factors include:

- . Possession of gas vacuoles providing buoyancy regulation, which allows them to overcome the spatial separation between light and nutrients.
- . Nitrogen fixing capability which enables them to dominate in low nitrogen waters.
- . Production of spores or "akinetes" which can last for several years and provide a means of seeding water bodies.
- . Production of toxins which kill or inhibit their predators and which may inhibit their competitors.

3. FACTORS AFFECTING BLUE-GREEN ALGAL BLOOMS

The multiple causes and effects of these blooms form a complex interactive system (summarised in Figure 2). An understanding of the relationships is necessary if the role of groundwater is to be understood, and if successful management is to be implemented. In resource management, decisions will need to be made on the best target area, be it at the causes, the algae itself or at the effects of their growth.

Algal growth is determined by many environmental factors (physical, chemical and biological) described in Reference 1. Because these factors are continually interacting with one another in a complex way it is not possible to attribute algal occurrence to any specific set of factors.

Physical factors include temperature, evaporation, light, turbidity, flow, turbulence, flooding, thermal stratification, depth and morphology of water bodies, and sediment.

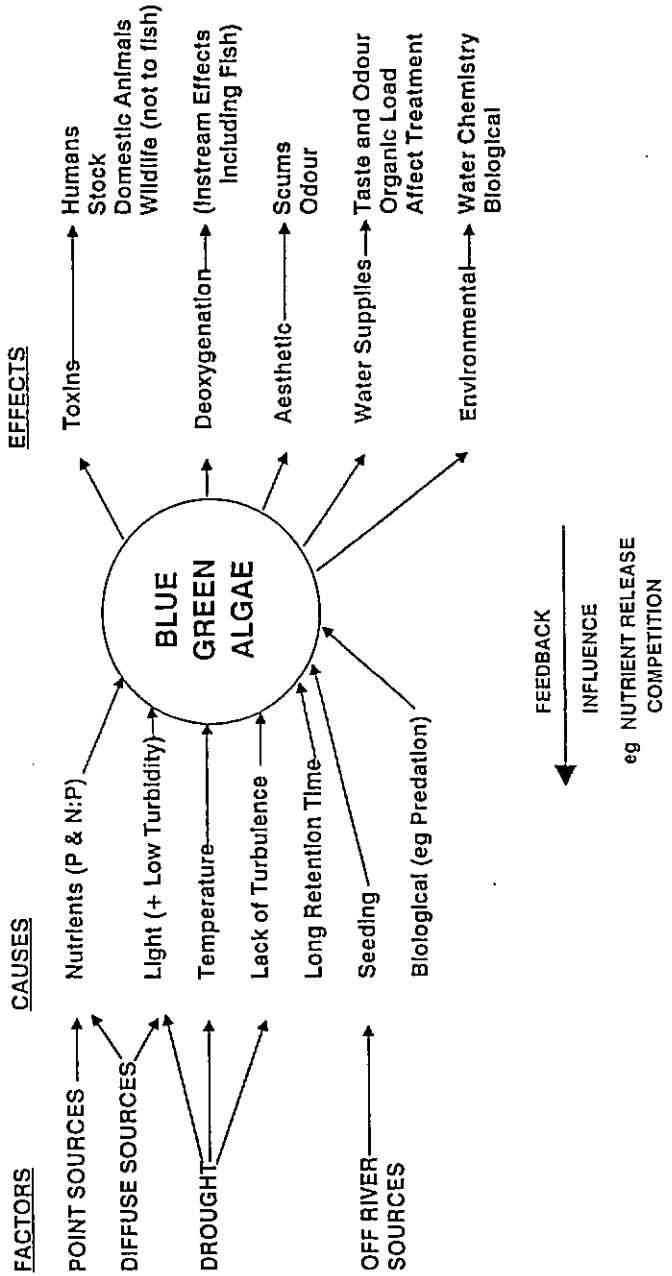
Chemical factors include nutrients, carbon dioxide, pH, trace elements and dissolved oxygen. The main chemical factor is nutrients; nutrient inputs from catchment point and diffuse sources, and from internal recycling from sediments within waterways. The most important nutrients are nitrogen (N) and phosphorus (P), with phosphorus being the limiting nutrient for blue-greens. Furthermore, their development is favoured by a N:P ratio below 29:1.

Biological factors are complex; interactions between blue-green algae and other members of the food web (zooplankton graziers, macrophytes, fish and other microorganisms) can affect algal biomass.

BLUE-GREEN ALGAL BLOOMS

- MAJOR CAUSES AND EFFECTS

(From Reference 1)



From Reference 1, the environmental conditions which favour the development of blue-green algal blooms are:

- . high water temperature (20-30 C)
- . high pH (pH8-10) and low CO₂ concentration
- . abundant zooplankton (blue-greens relatively inedible)
- . low N:P ratios (less than 29:1) and high nutrient levels
- . calm water conditions
- . low light intensity.

4. IMPACTS OF ALGAL BLOOMS

As shown in Figure 2, blue-green algal blooms have a wide range of social, economic and environmental impacts. There are impacts on water supplies, human health, livestock, fish, native fauna and flora, recreation and tourism; the costs can run into millions of dollars. There are also major cost implications for water treatment works if upgrading is required to handle increasing taste and odour problems, toxins and organic loads arising from algal blooms.

5. GROUNDWATER FACTORS AFFECTING ALGAL BLOOMS

Conditions most favour the development of blue-green algal blooms during summer, particularly along the shallow margins of water storages, lakes and when rivers are at low flow approximating a chain of connecting pools. Groundwater inflow to these waterways can then comprise a large proportion of the surface flow, and can influence the factors which enhance or inhibit bloom development.

5.1 Physical factors

Groundwater inflows can help maintain more constant water temperatures in small surface water bodies, aiding bloom development. Similarly, groundwater inflows of high pH help enhance conditions. For example, high flows in the Darling River have a pH of 7-8 which favour greens over blue-greens; the pH of low flows during the 1991 blue-green algal bloom measured 8.6-9.7 and the corresponding groundwater inflows had a pH of up to 8.9 (Reference 3).

In periods of drought, large groundwater inflows in small streams can reduce retention time and inhibit bloom development, whereas inflows in large weir pools could help increase retention time and serve to prolong the impact of an algal bloom.

5.2 Chemical factors

Nutrients in groundwater may help enhance bloom development. Although phosphorus is derived from a range of point and diffuse sources, it is usually not encountered in high concentrations in groundwater (for example fertiliser derived P is often quite immobile in soils since it is bound to clay minerals and other soil components). However, in sandy soils overlying a shallow groundwater table (Perth, Botany Basin) or where land disposal of phosphorus rich wastewaters exceeds a soil's assimilative capacity, phosphorus can reach the groundwater table. Movement of these groundwaters into a waterway will add available phosphorus to the water column and enhance algal bloom development (the recommended limit for phosphorus in our waterways is 50 ug/L).

Groundwater may also be high in nitrate concentration; the movement of such groundwater into a waterway may help increase the N:P ratio and help favour the growth of green algae over blue-greens.

Groundwater inflows high in sulphate concentration added to algal organic matter (in the bottom sediments) suitable for the metabolism of sulphate-reducing bacteria can activate the bacteria in the sediments. The waterway bottom water can become anoxic, with resolubilisation of some of the phosphorus bound in the sediments. The resulting feedback can release a pulse of soluble reactable phosphorus into the water column, causing an algal bloom (Reference 2). Such conditions exist along the Darling River for example. Although sulphate concentrations in the river are generally not high (10-30 mg/L), in early 1991 sulphate concentrations of 70 mg/L were measured in sections of the river, eg Louth (Reference 3), indicating possible inflow of sulphate-rich saline groundwater.

Also at times of low river flow, saline groundwater inflows into river bed depressions may occur (examples are known for the Darling River). The change in the ionic balance of the river caused by these inflows could cause sediment flocculation, resulting in much lower turbidities coinciding with low flow and warm conditions. If the river water has high concentrations of phosphorus (such as in the Darling River), algal growth can commence (Reference 2).

6. ALGAL BLOOM IMPACTS AND GROUNDWATER

6.1 Algae Contingency Plans

Algae contingency plans have been developed in many States, to varying degrees, to plan for the effective management and control of algal blooms, in order to minimise their occurrence and impact. The plans include monitoring, communications and response components. For States such as New South Wales, Victoria and South Australia where most communities rely on surface water supplies, the contingency plans are costly and need to be comprehensive (including the identification of alternative water sources) to safeguard public health.

However, the algae contingency plans for many regions in Queensland and the Northern Territory are simpler and far less costly. Because domestic water supplies are groundwater sourced, public health issues in these regions relate only to recreational use of surface waters.

6.2 Water Supply

From the experience of the 1991/92 summer, many communities currently on surface water supply will be considering the use of groundwater as an alternative (during algal blooms) or as a replacement source.

Pastoralists, farmers and irrigators will also be considering the greater security of water quality provided by a groundwater source. For irrigators in particular, the advantages of using groundwater include security of quality, greater security of quantity, and lower maintenance costs of irrigation equipment (no clogging of pumps, pipelines and sprinklers with algal biomass). These advantages need to be weighed against the generally higher cost of extracting groundwater.

7. CONCLUSIONS

While public attention on the blue-green algae problem has focussed on our surface water resources, there is also an important groundwater perspective. An

understanding of the relationship of the complexity of causes and effects is vital if the role of groundwater is to be understood, and if successful management is to be implemented. The availability of groundwater influences the structure and cost of algal contingency plans, and the provision of water supplies for a range of uses.

8. REFERENCES

1. New South Wales Blue-Green Algae Task Force (1992); Blue-Green Algae: Interim Report of the Task Force; published by the NSW Department of Water Resources; March 1992.
2. Donnelly, T.H., Wasson, R.J., Murray A.S., and Olley, J.M. (1992) Aspects of Sediment-Water Relationships in the Bourke Weir Pool; CSIRO Division of Water Resources; March 1992.
3. Williams R.M. (1991); Groundwater Inflow to the Darling River Mungindi to Wentworth: Run of River Study (1990/91); NSW Department of Water Resources, Technical Services Division Report TS91.041; August 1991.

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Manuscripts should be typewritten on one side of page only, double spaced, with at least one-inch (2.5 cm) margins all around. Authors in North America are asked to submit three copies of manuscripts and at least one copy of illustrations suitable for reproduction. Authors outside of North America may submit one copy of manuscript and illustrations. All papers, including illustrations, must be in English. SI units are preferred. If English units are used, equivalent SI units should follow in parentheses. Mathematical expressions must be legible and may be hand written; special symbols should be identified.

Titles of figures should be typed on a separate sheet, not lettered on the figure. Write figure number and name of author lightly in pencil on each figure. Number tables according to their sequence in the text and each should have a title above the table. Tables may be typed on separate sheets.

If possible, do not submit original ink drawings since APPLIED HYDROGEOLOGY cannot accept responsibility for their safety. However, if original drawings and/or photographs are submitted they will be returned to authors on written request. The size of illustrations may be, and usually are, reduced for publication; hence, lettering must be large enough to permit reduction.

Abstracts should be limited to 200 words or less and should be a concise account of information contained in the paper. Avoid expressions such as: "was investigated", "is discussed", "is described", and the like. Text should be limited to about 5,000 words plus about three pages for (reduced size) illustrations. Additional illustrations may be substituted for reduced pages of text.

List references alphabetically at the end of the text. Following are some examples of format.

- Freeze, R.A. 1975. A stochastic-conceptual analysis of rainfall-runoff processes on a hillslope. *Water Resources Res.* v.16, pp.392-408.
- Freeze, R.A. and J.A. Cherry. 1979. *Groundwater*. Prentice-Hall, Englewood Cliffs, NJ., 604 pp.
- Freeze, R.A., L. Smith, G. de Marsily, and J.W. Massman. 1988. Some uncertainties about uncertainty. *Proc. AECL/DOE '87 Conference on Geostatistical, Sensitivity, and Uncertainty Methods for Groundwater Flow and Radionuclide Transport Modeling*, San Francisco, CA. pp. 231-260.

Note that all lines below the first line are indented three spaces.

Place citations in the text within parentheses with the author's last name and year of publication. For example: (Smith, 1975), or (Freeze and Cherry, 1979). For more than two authors write (Freeze et al, 1988). Citations for authors listing more than one paper in the same year should be differentiated by the letters a, b, or c, following the year. If the author's name is part of the text, place the year only in parentheses.

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M E D I A R E L E A S E

AQUIFERS AT RISK: Towards a national groundwater quality perspective.

The Australian National University's Centre for Continuing Education is sponsoring a conference in Canberra, 15-17 February 1993, in co-operation with the Bureau of Mineral Resources, Geology and Geophysics, to provide a scientific and community forum for discussing a range of groundwater quality issues. This conference will be the ninth in the series, *Issues in Water Management*.

High salinity groundwaters have always been a constraint on water supply development in Australia and naturally occurring deleterious elements in groundwater such as nitrate, fluoride and heavy metals are a significant health hazard. What are the major occurrences of these elements and what can be done for remediation of small scale water supplies? Several important inland and coastal groundwater systems are affected by increasing salinity as a result of heavy abstraction of groundwater. How best can these systems be managed in view of increasing water needs in the community and the possibility of sea level rise induced by global warming? Several important regional groundwater systems are now known to be polluted by sewage and agrichemicals. Some of these aquifers are used for domestic purposes and others are connected to sensitive surface waters. What are the implications for waste management, land use and agricultural practice? Furthermore, an increasing number of local aquifers are polluted by toxic chemical and other wastes and petroleum products. How can these problems be managed: Can polluted aquifers and land be rehabilitated effectively? Are the health and environmental protection standards adequate?

The processes involved in groundwater quality deterioration and the management, remediation and protection of the nation's groundwater systems, will be reviewed in this conference.

CONTRIBUTIONS ARE INVITED and could be in the form of papers, poster displays or workshop sessions. Abstracts of papers will be considered by the conference committee and should be forwarded to Shirley Kral, Centre for Continuing Education, Australian National University, GPO Box 4, Canberra, 2601. Closing date for abstracts 31 May 1992.

For further information, please contact Shirley Kral, telephone (06)2494580, and fax (06)2573421

INSTRUCTIONS TO NEWSLETTER CONTRIBUTORS

In order to assist in the timely output of the newsletter all contributors to the newsletter are asked to supply their articles in final draft form by mail to the editor. All articles should be typed on good quality A4 white paper (faxes are not acceptable). There are no strict format rules and contributors are asked to use their own judgement on the style, keeping in mind that the article will be reduced to A5. Good quality figures in articles are encouraged.

Advertisements:

Advertisements will be included in the newsletter upon approval of the executive committee. The executive committee of the IAH reserves the right to refuse to include an advertisement if it deems it unsuitable to the overall spirit of the newsletter. There will be a charge of \$50 per half page of newsletter space for all advertisements. It is important to notify the editor of a request to advertise several months before the issue date of the newsletter in which it is to appear so that the executive committee has sufficient time to meet and assess the suitability of the advertisement.

Conference Notices:

Notices of conferences, especially those requesting a call for papers should be sent to the editor, well in advance of the date of the issue in which the notice is to appear. As there are no strict despatch dates for the newsletter we cannot guarantee that the deadlines contained in the notices have not been exceeded by the time members receive the newsletter. If possible one should aim to include such notices in a newsletter issue several months ahead of conference deadlines.

Garry Pantelis
Editor IAH Newsletter
Australian Chapter.