THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

No. 34 May 1992

The BHS response to environmental agency proposals

This is the text of the British Hydrological Society's response to the government's consultation paper "Improving Environmental Quality". It is based on the results of last year's questionnaire to members, which invited opinions on four options for a new environmental agency for England and Wales.

The British Hydrological Society has over 600 members, the greater part of whom have professional employment within some part of the UK water industry. The Society has charitable status and is one of the strongest of the learned societies for which the Institution of Civil Engineers provides secretarial support. Members come from within all sections, public and private, of water-related planning, design, operation, training, research, management and monitoring organisations.

The Society brings together the key groupings of those concerned with hydrology in Britain. Hydrological science traces the quantity and quality transformations of rain as it runs off and through the ground to rivers and seas. Consequently members are intimately involved with the environment and hence with the plan announced by Government for an Environment Agency.

In general terms the Society welcomes an Agency, having expected it earlier at the time when 'Our Common Inheritance' was being prepared by Government. Clearly the Government have a strong intention to get this important reorganisation right. Our members endorsed this with enthusiasm.

To ensure that this response carried weight the Society polled its members with a questionnaire. There were 124 replies, over 20% of the membership; the Society's government Committee believes those replies to be fully representative and unbiased.

There was a clear majority vote of 58% for the Government's third option, i.e. for a thoroughgoing single Agency that can bring NRA, HMIP and other pollution control personnel together without losing the key merits of those bodies. Only 10% said "no" to this option.

None of the other options would be favoured by more than 19% of those polling (Detailed figures are given in the table).

It is significant that some two-thirds (65%) were decidedly against the Government's fourth option. This is because it is seen as a solely regulatory body cut off from present colleagues able to provide essential know-how and data. Professional hydrologists see a severance of water quality personnel from those in hydrometry, water resources, flood control, fisheries, and conservation as being highly retrograde. This is the era of major integrated data systems and of water quantity/quality models that are at last revealing how each of our rivers lives and breathes.

Overwhelmingly members stress their desire to retain and enhance **integration** in environmental management. Every proposal and legislative clause should be tested by that touchstone. Similarly any cause of **fragmentation** should be assiduously removed.

The third option was seen as:

- the best solution for truly integrating water cycle monitoring;
- likely (with care) to minimise bureaucracy and reduce total cost;
- seizing a timely opportunity;
- potentially creating economy of scale;
- reducing duplicated activity;
- cohesive, with clear missions that balance positive and negative activities;
- giving a higher profile to environmental protection in society;
- having fuller scope to handle unforeseen regional environmental crises into the next generation;
- retaining the NRA's success in the courts;
- giving maximum authority over polluters;

- needing care not to grossly disturb the NRA's current growing effectiveness;
- giving a 'one stop shop' with in-house liaison;
- recognising an indivisible environment.

By contrast the fourth option is heartily disliked with members using terms such as "it would dissipate nearly 20 years of achievement", "a recipe for disaster", "the loss of integrated catchment management" and "if it requires statutory liaison then it will not work".

In particular the hydrological profession could see its valuable role reduced to one of mere support. If this least welcome option is brought into being, then inevitably it will have to eventually duplicate many of the hydrometric and resource modelling skills now resident in the NRA. The pool of qualified would take time to train new teams and bring them up to a proper level of experience to avoid misjudgments.

The second option fares little better with most members, being described as "a powerless quango" and "vulnerable to demarcation disputes".

The first option drew some support because of its air and land theme, leaving the NRA relatively unscathed; it might also assist Integrated Pollution Control in those spheres. However it could be seen as weak on issues such as acid rain and tip leachate control.

We commend to the Department of the Environment and the Welsh Office several matters of legislative importance that warrant consideration (which are not ranked for priority here):

- The new Agency could usefully take over activities now within the local authority remit:
  (i) responsibility for all unlicensable private water supply matters
  (ii) the consenting of natural mineral waters
  (iii) drainage channel maintenance above current 'enmained' reaches (but still respecting Internal Drainage Board roles)
- The relationship of other Inspectorates to those likely to be within the Agency. These include the Factory Inspectorate, the Railways Inspectorate and perhaps more fundamentally the local Environmental Health Inspectors. These last named might be brought within the agency if it had a clear local office strategy.
- Leaving the way open to privatise laboratories (but not the chemical and microbiological standards to which they work) if it is felt that total staff size of the Agency must be reduced.
- Either moving all NRA navigation and harbour responsibilities to British Waterways or bringing British Waterways within the Agency.
- Removing the restriction on balancing budgets within each core function of the NRA whilst strengthening the financial management overall.
- Giving the Agency a remit to publish (or arrange for others to publish) comprehensive environmental statistics that go beyond the current limited range put out by government.

Establishment of a proper funding base is seen to be important. Lessons remain to be learned from Audit Commission reports.

Conclusions

The poll was so clear-cut that this response need not labour the arguments for a single strong Environmental Agency. Members of the Society feel strongly that it is essential for the professional efficiency and effectiveness of the new pollution control agency that it should have both quality and quantity measurement skills. To lose the latter from the new organisation would be a guarantee that it could not carry out its work authoritatively.

The Society therefore urges Government to legislate for the third option, a fully-fledged Environment Agency, and not to flinch from managing the large staff size involved. That option has subsidiary choices to be made within it but those are seen as less crucial.

The precise legislation is so important that it warrants time for consultation on detail; the Society would be pleased to assist in this process in those areas within its competence.

Government is asked to consider the long-term value of achieving convergence in the organisation of environmental management agencies in the constituent countries of the United Kingdom. Logic and efficiency demands it.

TABLE

124 members voted, just over 20% of those on our latest membership list.

	First Option	Second Option	Third Option	Fourth Option
YES	19%	15%	58%	8%
NO	11%	14%	10%	65%

Thus members clearly favour the all comprehensive EA that would unite NRA and HMIP. An even bigger majority of BHS are against a new little agency limited only to environmental policing.

Lynmouth — 40 years on

BHS South West Section Meeting
Exeter University
6 December 1991

Bill Harris, **Chairman of ICE's Welsh Hydrological Group, gave an interesting presentation based on his experience of the Lynton-Lynmouth floods of 1952. Nearly 40 members and guests attended this South West section meeting in the Department of Geography at the University of Exeter, including consultants, academics, research students and NRA personnel.**

Bill Harris introduced his lecture by reviewing the hydrometeorological conditions relating to the severe thunderstorms which took place over Exmoor on Friday 15 August 1952. On that day, 9.1 inches of rainfall were recorded at the Longstone Barrow gauge which was sited within the River Lyn catchment area. Subsequent work by the meteorological office deduced that nearly 6 inches of rain had fallen in four hours with a peak intensity of 1.6 inches per hour. Additionally, as over 6 inches of rain had fallen during August of 1952, antecedent ground conditions were saturated over much of the Lyn catchment. Thus further intense rainfall rapidly led to overland flow conditions

and subsequent high river discharges and flooding.

The results of this event were devastation: 31 people lost their lives, 93 houses were destroyed and a further 72 damaged, 28 bridges were swept away or damaged and over 120 vehicles were lost.

Bill then outlined how maximum flow assessment has been carried out as a necessary hydrological background to the subsequent flood alleviation scheme.

Firstly, slope/area measurements were made at 12 sites throughout the drainage system. At each site, four cross-sections were taken, about 100 yards apart, which had been selected for straightness and uniformity.

Values of 'n' to be used in the Manning formula were chosen, these varied between 0.08 and 0.06 with 0.05 being used for the wooded sections of the drainage systems. From these, the peak flow in the West Lyn was calculated to have been 8630 cubic feet per second (cusecs), while that of the East Lyn was 15290 cusecs - giving over 23000 cusecs through Lynmouth village itself. (Note: 1 cusec = 0.028 cumecs and 1 cumec = 19.005 Mgd).

Secondly, a model of the West Lyn constructed in the hydraulics laboratory at Imperial College, London gave test results of maximum flood flows equivalent to 8000 cusecs.

Thirdly, the Meteorological Office isohyetal maps were used to calculate the maximum rate of run-off from the combined Lyn catchments and gave a value of 22,000 cusecs. Although the latter calculation was felt to be less reliable than the other methods it did confirm that the overall figures were of the right order.

Ultimately the flood alleviation scheme that was accepted created a two-stage channel over 100 feet wide, designed to accommodate both design flows and any floating debris that may become incorporated in subsequent high flows.

Bill Harris then posed the questions "What is the estimated return period?", "Could it all happen again?" and "How does rainfall/runoff for Lynmouth compare with other extreme events in south west England?".

Between 1893 and 1960 rainfall exceeding 4 inches has been recorded on 450 'rainfall days'. However, in most cases intensity and duration relationships are unknown, making comparisons of return period between sites in differing catchment areas somewhat problematic.

Referring to a list of notable floods for South West England, it was pointed out that quite often the precise location of a storm event in a catchment in relation to land use (especially flood-plain construction) is just as important as antecedent conditions, rainfall intensity or rainfall duration. This was illustrated in the flooding in Polperro (1976) and at Truro (1988).

There was, in Mr Harris's view, no doubt that extreme rainfall could and would recur: in fact there was some evidence their frequency and severity were increasing. However, the work of the National River Authority and its predecessors during the last 40 years should provide considerable reassurance. In 1952 none of the rivers within the Lyn catchment was a scheduled 'main' river. Both the East and West Lyn together with their principal tributaries are now scheduled and maintained. Comprehensive flood warning schemes have been established and extended using modern sophisticated technology. Water level sensors are established in the rivers upstream of danger points to give threatened communities a 30-minute warning of rapid rise in river levels. This information is also transmitted to the Flood Duty Officer. Weather conditions are continually monitored through radar and the effect of each heavy downpour is processed by computer. The computer programs include data on antecedent ground conditions, stream levels and individual catchment characteristics. Written procedures listing all factors affecting potential flood risks in each part of the catchment are being established. Operation staff are alerted and colour-coded warnings are issued to the police. An Emergency Liaison Officer maintains contact with local authorities and with the public.

Mr Harris concluded his review by pointing out that although work still needs to be done, the chances of fluvial or tidal disasters are considerably lessened. However, there is no cause for complacency as there is still pressure for building encroachment onto flood plains. The need exists for publicity to bring the potential dangers to the notice of unsuspecting property owners. Indeed at a meeting of the Hazards Forum in 1990, it was suggested that although often done voluntarily, it should be mandatory for solicitors investigating title to a property on behalf of a purchaser to contact the NRA about flooding dangers, in the same way as other service undertakings are approached.

Peter Sims
Polytechnic South West

The Second Postgraduate Symposium

University of Edinburgh
10-11 April 1992

Frogs in bogs and poodles in noodles were among the problems highlighted at the Society's Second Postgraduate Symposium, held in the comfort of the University of Edinburgh Staff Club. Twenty-six students at various stages of their MSc and PhD programmes attended, twelve stimulating talks were presented and there was a lively discussion on the problems of carrying out PhD research.

As with the first symposium, held at Loughborough in March 1990, the aim was to enable postgraduates to gain experience in the presentation of research work and to discuss ideas and difficulties within their peer group in an informal setting. In this case the symposium was timed to follow on immediately from the XVII General Assembly of the European Geophysical Society (EGS), which took place in Edinburgh during 6-10 April, so that students also had the opportunity to rub shoulders with the wider hydrological community.

Kielder keeps the taps flowing

The symposium opened on the Friday evening with a Society reception,



attended also by hydrologists and a few stray geologists from the EGS General Assembly. **Dr John Mawdsley** (National Rivers Authority, Newcastle upon Tyne) then gave a guest presentation on the Kielder Reservoir and Water Supply Scheme in north-east England. John began with a general description of the scheme, its operation and how it was intended to supply industry on Tyneside, Wearside and Teeside. However, underused as a water supply scheme as a result of industrial recession, Kielder Reservoir was instead used throughout its first decade more to support recreational activities and to generate hydro-electricity.

Recently, though, as successive years of low rainfall have left other parts of England struggling with hosepipe bans, the huge capacity of Kielder Reservoir has enabled the north-east to remain smugly buffered against climatic vagaries. Indeed, so successful has the scheme become that covetous eyes have been turned in its direction, with suggestions that it should supply water to the south and possibly to a nuclear power station in Scotland.

Finally, the requirement for the NRA to consider the broad environmental needs of the Tyne downstream from the reservoir has resulted in the careful programming of water releases and an interesting study of the impact of releases on aquatic ecology.

Mires, reservoir control, floods, soils and models

The symposium continued on the Saturday with presentations by the postgraduates. Chairing the morning session, **Frank Law** (Institute of Hydrology) reminded participants that they were likely to be in touch with each other as colleagues, clients, contractors and opposing experts for the rest of their working lives. The symposium was therefore a good opportunity to make early contacts!

Opening the presentations **Rita Smit** (Department of Biological Sciences, University of Dundee) discussed her work on methods for the derivation of a seepage hydrograph for a Scottish raised mire. Conversion of an existing fifteen-year stage record to give discharge has been hampered by difficulties in determining the stage datum (partly caused by frogs jumping on the float) and a geochemical study is being carried out to provide a more accurate estimation of the seepage.

Anthony Tollow (Department of Civil Engineering, University of Durban-Westville, South Africa) went on to discuss aspects of operational control rules for the three-reservoir system along the Umgeni River. A monthly simulation model has been written and used to test the concept of "control bands" and subsequent work has led to the development of a second model demonstrating the effects of water saving in industry on demand. **Ahmed El-Hames** (Department of Geography, University of Cambridge) then talked on flood prediction in arid regions. As a result of the poor availability of data with which to build traditional flood prediction models for such regions, he is concentrating on a physically-based approach accounting for infiltration, overland flow routing and channel routing.

Andrew Black (Department of Geography and Geology, St Andrews University) continued with a talk on characterising seasonality in flooding: some seasonal problems and solutions. Using some attractively shaded maps, he showed that classification analysis provides an effective means of condensing a number of variables in order to summarise the seasonal distribution of flood events.

Winding up the floods session with a talk on the flood hazard in Peninsular Malaysia, **Ngai Weng Chan** (Flood Hazard Research Centre, Middlesex Polytechnic) began by observing that since his recent arrival in Britain, he was constantly being accosted by old ladies walking their poodles and asking him if he ate dogs! He went on to describe the objectives of his work as defining the different types of flood, constructing a flood hazard response model for Peninsular Malaysia, investigating how floodplain inhabitants perceive flood hazards and plan mitigation strategies and policies, and evaluating the performance of flood warning systems.

At this point I took over as chairman and **Oliver Sililo** (School of Earth Sciences, University of Birmingham) presented a talk on the effect of heterogeneity in unstructured systems on unsaturated zone flow. Using results from a laboratory study he demonstrated the importance of vertical fingering in the downward movement of water through the unsaturated zone and discussed the approach to laboratory representation of the process.

Still on soils, **Ed Henderson** (Centre for Research on Environmental Systems, University of Lancaster) discussed some hydrological observations from experiments on soil cores from Slapton, Devon, as part of the NIREX Safety Assessment Research Programme. Tracer experiments have indicated the importance of preferential pathways for water movement in the soil and the data have been used to examine parameter evaluation for the convection-dispersion equation.

Moving on to modelling but staying with the University of Lancaster, two presentations were made on TOPMODEL applications. **Jim Freer** described an application to Maimai catchment in New Zealand, highlighting the difficulties of evaluating model parameters. Simulations should therefore be carried out with different evaluations drawn from a realistic range. **James Fisher** then talked on internal state data — opening the can of worms on catchment hydrology. Using an application of TOPMODEL to Slapton Wood catchment in Devon, he discussed the difficulty of obtaining distributed internal state data, in this case for soil moisture, using remote sensing techniques.

Harvey Rodda (Department of Geography, University of Exeter) presented his work on the development of a nitrogen cycle model to predict nitrate losses through leaching from grassland catchments. The model is being tested in twelve catchments and is being used to examine trends in leaching over the last fifteen years. **Alan Howard** (School of Geography, University of Leeds) then talked on modelling the processes of blue-green algal blooms. He described his aptly named SCUM model which simulates the vertical and horizontal movement of algae in lakes and reservoirs and demonstrated its application with some colourful graphics displays.

In the final talk, **Ashie Akpoji** (Laboratory of Hydrology, Free University of Brussels) described a three-dimensional finite element model for groundwater flow and pollutant transport. Solution techniques for the equations have been developed which offer considerable savings on computer memory space and processing time, and good agreement between model results and analytical solutions has been obtained.

PG tips

There followed a lively discussion on the problems of postgraduate study in the UK, with supervision taking the brunt of the criticism. It was recognised that thesis supervisors have many claims upon their time, but there was a strong feeling that more contact hours were required. Especially in the first year of a PhD it was important to receive more direction, enabling students to gain confidence and develop the ability and knowledge to work on their own. Several participants

had also found that a PhD was not turning out to be as they had originally imagined it. They felt that more information about what is involved should be made available at the interview stage, for example the fact that everything takes three times longer than expected!

There was discussion on the time needed to complete a PhD and whether three years is still adequate. Overseas students tend to complete on time (albeit under considerable stress) because they have to return to their country, but home students frequently take more than three years. It was suggested that a time plan drawn up with the supervisor could help in time management, although it should not be so rigid as to stifle creative thinking. There is still a need for the notebook on the bedside table to record the vital idea that springs to mind at 3 a.m.!

Finally, the means of incorporating some practical training into the PhD programme was discussed. Course work, along the lines of the United States system, was thought to be useful for focusing on the subject and developing confidence. Doing a PhD as part of a job had the advantage of better pay as well as practical application but could take double the time. CASE studentships (involving formal contact with an outside organisation) were considered to be a good way to obtain practical experience.

Conclusions

To complete the symposium, I gave a talk entitled "Potamology, fluvial terrorism, the SHE and meaningful relationships". This was intended to be a light-hearted attempt to put the individual PhD studies in context by presenting an integrated view of hydrology, sediment transport and contaminant migration at the catchment scale. I took a somewhat personal approach, using the extension of the SHE hydrological modelling system to form the SHETRAN-UK hydrological, sediment transport and contaminant migration modelling system at the University of Newcastle as a basis for discussing the process studies and data collection needed to support model development. Our poor understanding in a range of areas provides fertile ground for further PhD research!

The enthusiasm and liveliness which permeated the symposium suggests that its aims were successfully achieved and that the participants enjoyed themselves. To me, the wide range of research topics, the high standard of work presented and the interested discussion of each talk indicate a bright future for hydrological research at the hands of a formidable talent.

Finally, many thanks to **Dr David Ledger** (Institute of Ecology and Resources Management, University of Edinburgh) and to **Professor Ken Creer** (Department of Geophysics, University of Edinburgh) and his EGS Local Organising Committee for their help with local organisation of accommodation, meeting room and eating arrangements.

James C Bathurst
Department of Civil Engineering
University of Newcastle upon Tyne

Postgraduates speak

The following participants kindly reported their views on the symposium:

Kevin Jenkins (School of Earth Sciences, University of Birmingham):

I came to the symposium with curiosity and some trepidation. Basically a geologist with eight months of an MSc in hydrogeology behind me, I wasn't entirely sure what to expect. As it turned out, most of the other participants were equally uncertain as to what would happen. This didn't prevent an excellent meeting with some fascinating talks and interesting discussion.

So what did I learn? Well, a lot about the problems of man meeting nature in the raw. These can be especially frustrating for the field scientist, for example with frogs leaping on and off floating water level recorders, and there was the story of the group whose discharge recorder, placed in a normally dry channel, measured no flow for three years and was then washed away when a flood eventually came!

Attempts to bring nature under control often seemed to fare no better. Hence we learned that flood hazard maps cannot be published because they lower property values, that flood defences encourage people to build in the 'protected areas and so increase the damage caused when sufficiently large storms occur, and that monsoon drains create dangerous underwater currents to sweep away the unwary.

The symposium finished with a discussion about the difficulties of doing PhD research. This was particularly interesting, with many problems being common to all disciplines. All in all a worthwhile meeting, and one which many participants felt should be repeated on an annual basis.

Ngai Weng Chan (Flood Hazard Research Centre, Middlesex Polytechnic):

This symposium was certainly one of the most beneficial that I have attended from the view of a postgraduate student, giving postgraduates working in the hydrological or related fields an overview of the kind of projects that are being carried out. The symposium gave the students an opportunity to get in touch with people (not just students but eminent hydrologists as well as personnel from water bodies such as the NRA) and seek professional advice on their projects.

Although my PhD project is vastly different from any of the other projects currently being carried out, the other projects presented have given me a wider perspective on the kinds of approaches to hydrological problems.

Most of all I made a lot of new friends with mutual interests. Who knows, one day some of us may be collaborating in research or consultation projects. I certainly hope that the BHS will put this symposium into their annual calendar and run it every year.

Anthony Tollow (Department of Civil Engineering, University of Durban-Westville):

The informal and comfortable surroundings of the University of Edinburgh Staff Club, contrasting with a week of hard chairs and austere lecture theatres at the EGS General Assembly, generated lively discussions and a very convivial atmosphere for the exchange of ideas. All the presentations were of a commendably high standard, although the session chairmen had to exercise discreet time control! All agreed that it was a very worthwhile exercise which could be repeated, perhaps at two-year intervals.

Rita Smit (Department of Biological Sciences, University of Dundee):

The symposium turned out to be very successful for several reasons. Firstly, the atmosphere was informal, which made it possible for everyone to feel free to join in the discussion. It also made it easy for people to present their work and especially to discuss the problems they had come across.

Secondly, the projects discussed at the symposium were interdisciplinary in nature and required knowledge from different fields, such as hydrology, chemistry, geology, ecology, sociology and economics. The participants came from different backgrounds so they were able to offer each other ideas and to fill the gaps in each other's knowledge. This was most useful, especially for first-year students, as there was a common feeling among many of the participants of being isolated in their work.

Thirdly, general problems in doing a PhD were discussed: this was useful to keep one going and to prevent the feeling of being the only one who has to go through all this. I certainly feel that it would be very useful to have this symposium as a yearly event so that people can come back to talk about their progress within their own peer group.

Rainfall frequency analysis and modelling

BHS Southern Section Meeting
Imperial College, London
5 February 1992

On Wednesday 5th February 1992, two talks were given at Imperial College on a much neglected area of hydrology: rainfall. The first talk, by Lisa Stewart (Institute of Hydrology) presented some results of recent research in the field of rainfall frequency estimation. The applications range from hydrological design to retrospective analysis of events.

The current practice in the field is to use the results published in the Flood Studies Report, Volume II (1975) where the index variable is M5 - 2 day rainfall and the growth curves relate M5 rainfall to that of the required frequency. However, this method does not allow for a proper representation of the regional differences: the frequency of extreme events in the West Country, for instance, is underestimated. Moreover, the results are based on pre-1971 data.

The requirements of the current research are to exploit fully all available data, to avoid fixed geographical boundaries and to provide frequency estimates for higher return periods. The focused Rainfall Growth Estimation (FORGE) method uses a modified station-year approach to allow for the spatial dependence of rainfall extremes and produce a growth curve focused on a particular location. Reed and Stewart (1989) have applied it to rainfall growth rates in south-west England (see Figures 1 & 2).

The method allows the growth curve to be focused on a particular location: the modified station-year method is applied repeatedly to larger and larger networks of gauges centred on the subject site, although in practice it starts with the largest network and works downwards. Then a Perturbed Gumbel Distribution is applied to the maxima. The standardised maxima are related to the reduced variate by:

$$x = u + ay + b\,(y - y_p)\,\exp\left[-c\,(y - y_p^2\right]$$

Rainfall statistics are then mapped using geostatistical techniques such as co-kriging (a type of kriging taking into account additional variables which are spatially correlated).

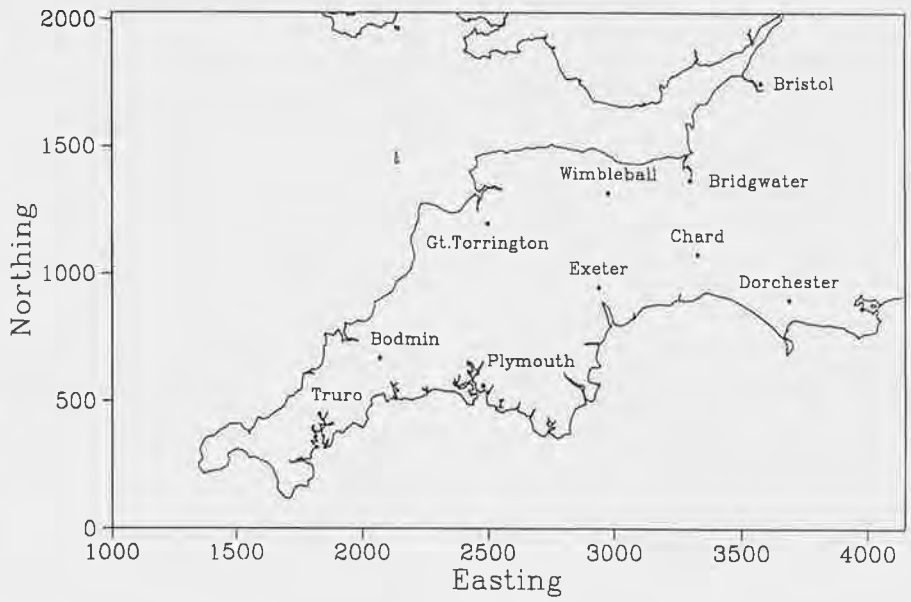
Future research will concern the examination of the whole of the country with these methods and their use for hourly data (only daily data have been examined so far).

Questions from **Howard Wheater** and **A. Butler** (Imperial College) focused on the problem of the possible anisotropy of the field of extreme values and the dependence on such factors as orography. **Duncan Reed** (Institute of Hydrology) indicated that it was planned to investigate the inclusion of factors such a orography in the spatial dependence pattern. **Peter Adamson** (Halcrow) suggested that when looking at extreme rainfalls for N days, the synoptic character of the event could not be overlooked and therefore, what is really of interest is not point but spatial rainfall.

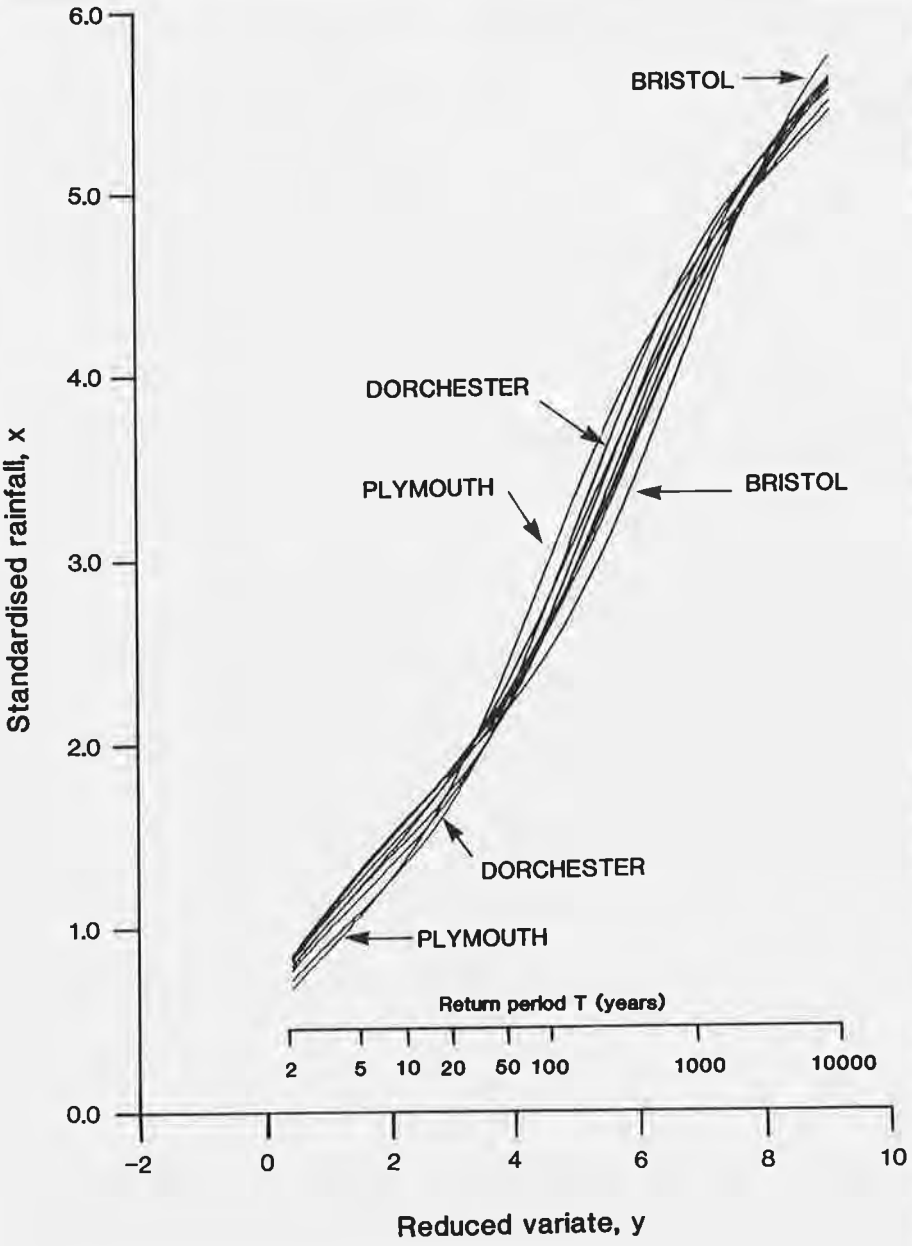
In the second talk, **Peter Adamson** (Halcrow) examined the notion of drought. A display of his work in this field before the beginning of the meeting presented some of his ideas. Chiefly, what is at issue here is the problem of asking the right question. Looking at the droughts of 1976, 1984 and 1989 in the UK, it appears that there is a need to monitor droughts on a daily basis and to follow the accumulation of deficiencies in rainfall. Because the 1989 Water Act, refers to 'exceptional shortage of rain', it is necessary to provide some measure of 'normal' rainfall against the severities of deficiencies which may be recorded.

A drought is a multifaceted process which may be recorded in terms of duration, intensity, risk of occurrence and areal extent. The method used must be statistically and intuitively correct and accord with the public view of the drought process. Measures of wetness/dryness at each point must take into account antecedent conditions and the seasonal cycle of rainfall amount must be acknowledged. Finally, the effects of the drought, in particular on secondary and tertiary processes of interest such as soil moisture, should be quantified.

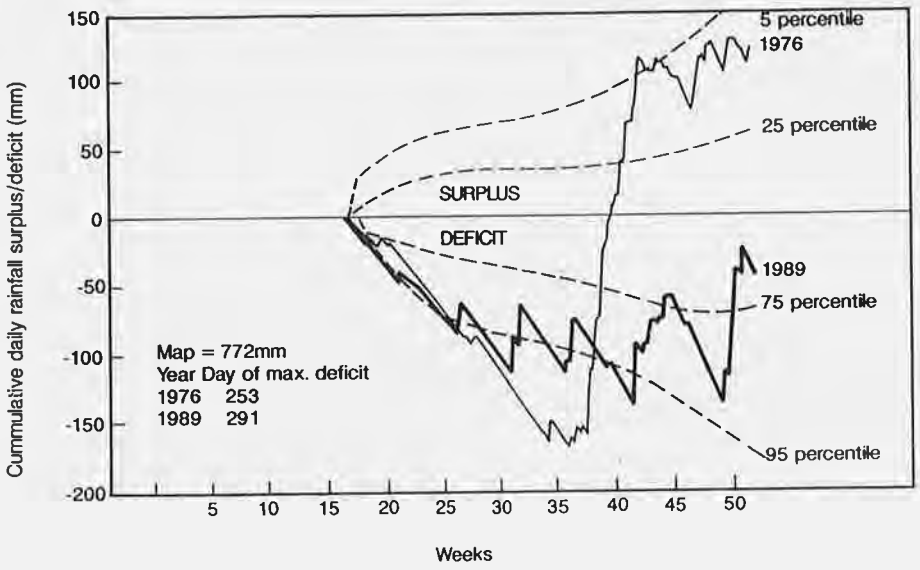
The drought process is defined by a



Location map of south-west England



FORGE curves for south-west England (1-day rainfall)



Exeter: seasonal accumulated rainfall deficits, starting 1 May 1976 and 1989

random origin in time, a random duration and a random intensity (maximal departure below expectation during an event). Thus by fitting a Fourier function to apparently very noisy data, the probability of a wet day is estimated for each day of the year and similarly the mean daily rainfall is estimated. A curve representing the expected cumulative rainfall for each day of the year was then plotted for the case of Exeter.

The 1976 and 1989 data sets show a considerable deficit below this curve. The cumulative rainfall deficits may however be computed starting on any particular day. For instance, if we compute the deficits from the 1st May, instead of starting on the 1st January, 1976 no longer appears to be such a severe event, but 1989 appears to be a very severe drought (see Figure 3). On the other hand, if we start the year before, it becomes apparent how bad it was in 1976.

A comparison can then be made between stations for maximum deficit or for occurrence of the day with the maximum deficit. These ideas may also be extended by looking at filtered rainfall: rain falling on day n has a benefit on days n+1, n+2, ... and this may be accounted for by using an exponential filter: $f(t) = p^t$. Finally, a stochastic model could be used to estimate probabilities of drought, an exercise the author carried out for 2500 sites in Southern Africa.

Terry Marsh (Institute of Hydrology) asked about the use of hydrologic data (e.g. groundwater level) to look at droughts. In fact streamflow could in a sense be taken into account by the filtering techniques, but bringing more data into the picture will lead to a complicated multivariate problem. Another questioner made the point that what we are interested in is in fact the definition of a drought in terms of groundwater and reservoir levels, and **Frank Law** (Institute of Hydrology) emphasised the need to examine the drought-usage relationship. This talk, however, clearly outlined the importance of examining the rainfall data connected with dry periods and using it in different ways to isolate characteristics of a given drought.

Christian Onof
Imperial College

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Thirty years of flow measurement standards

BSI

BSI is a unique organisation, independent and impartial and working closely with industry, research associations, professional bodies, central and local government and users for the benefit of the community. It originated in 1901 as the Engineering Standards Committee, set up by the Institution of Civil Engineers and other professional bodies and was granted a Royal Charter in 1929.

BSI Budget

BSI has an annual budget of some £25 million. Standards work is paid for by income from sales, government grant-in-aid and subscriptions from some 27,000 firms, trade associations, local authorities, professional institutions and other bodies.

Streamflow Committee

The streamflow committee (now the Committee on Flow Measurement of Surface and Ground Water) was instituted in 1956 and the first committee structure was set up in 1958. It was not until 1962, however, that the first standard was approved (published in 1964). Today there are some 40 standards on flow measurement, many of which have been revised and improved several times. The committee structure now includes groundwater and precipitation measurement (see figure).

Committee Structure

The Technical Committee on Flow Measurement of Surface and Ground Water (PCL/3) comes under the Electrotechnical Divisional Council (L/-). The reason for this seeming anomaly is lost in the mists of time but is purely historical and the arrangement has worked surprisingly well in practice. Technical Committees in the water industry, as a whole, are spread throughout four of the six Divisional Councils. The water quality technical committee reports to the Chemical and Health council (C/-), 'flow rates for taps' reports to the building and Civil Engineering Council (B/-), and 'valves' reports to the Engineering Council (E/-).

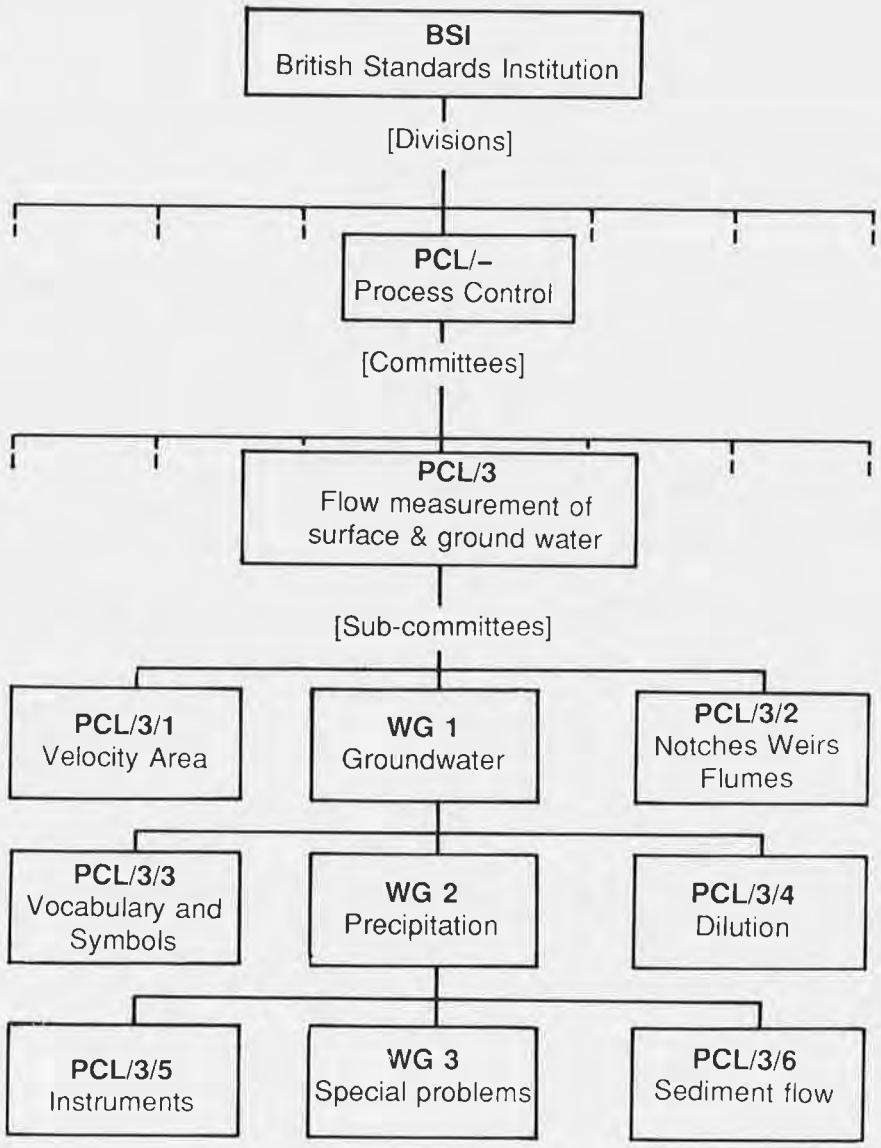
Present Work

Ongoing work by the Sub-committees includes the following:

- Safe practice in hydrometry
- Electromagnetic current meter
- The ultrasonic method (revision of existing standard)
- The electromagnetic method (revision of existing standard)
- Vocabulary and symbols (revision of existing standard)
- Time of travel
- Test pumping wells (revision of existing standard)
- Hydrometric data management (being prepared by IH)
- The stage discharge relationship (revision of existing standard)
- Compound gauging structures
- Vertical underflow gates
- Modelling unsteady flow
- Stresses in cableways
- Establishment and operation of a gauging station (revision of existing standard)
- The moving boat method (revision of an existing standard)
- Precipitation measurement
- Sand bed material sampling
- Bedload sampling in steep mountain rivers
- Free surface flow in closed conduits (sewers)
- Flow in unstable channels and ephemeral streams
- Research into compound weirs without divide walls (pending)
- Research into vertical underflow gates (pending)

International Standards Organization

Out of over 40 ISO Standards on Flow Measurement, the UK Committee has



Part of the British Standards Institution structure

been responsible for the drafting of 70 per cent. The BSI practice is still followed: do it once; do it right; do it internationally. Most of the British Standards have therefore started and finished as International Standards. The ISO flow measurement standards are now used in practically every country in the world and countries directly involved in the formulation of the standards represent 75% of the world's population.

CEN

The European Community has recently shown interest in hydrometry and BSI has formally initiated the possible formation of a Technical Committee on the subject. The result should be known shortly. European standards are prepared by the European Committee for Standardis ation (CEN) published in an EN series and regarded as providing technical criteria for use in EC Directives by reference. The member countries of CEN comprise all the EC and EFTA countries. It is anticipated that ISO standards would be adopted by CEN with or without amendment.

The need for standards in hydrometry

Whilst no one element of society, whether industry or government, is competent to keep pace with a rapidly changing technology, a standard written by representatives from all the affected segments is likely to be unbiased, authoritative and utilised. Standards are not intended to be restrictive but are meant to establish a measure of uniformity so that the data derived will be compatible and comparable. The user may choose the method which best suits the particular situation from those available. The door should be, and is, left open for new developments: the fact that there is a standard method in no way deters hydrologists and others from searching for an even better method.

New work

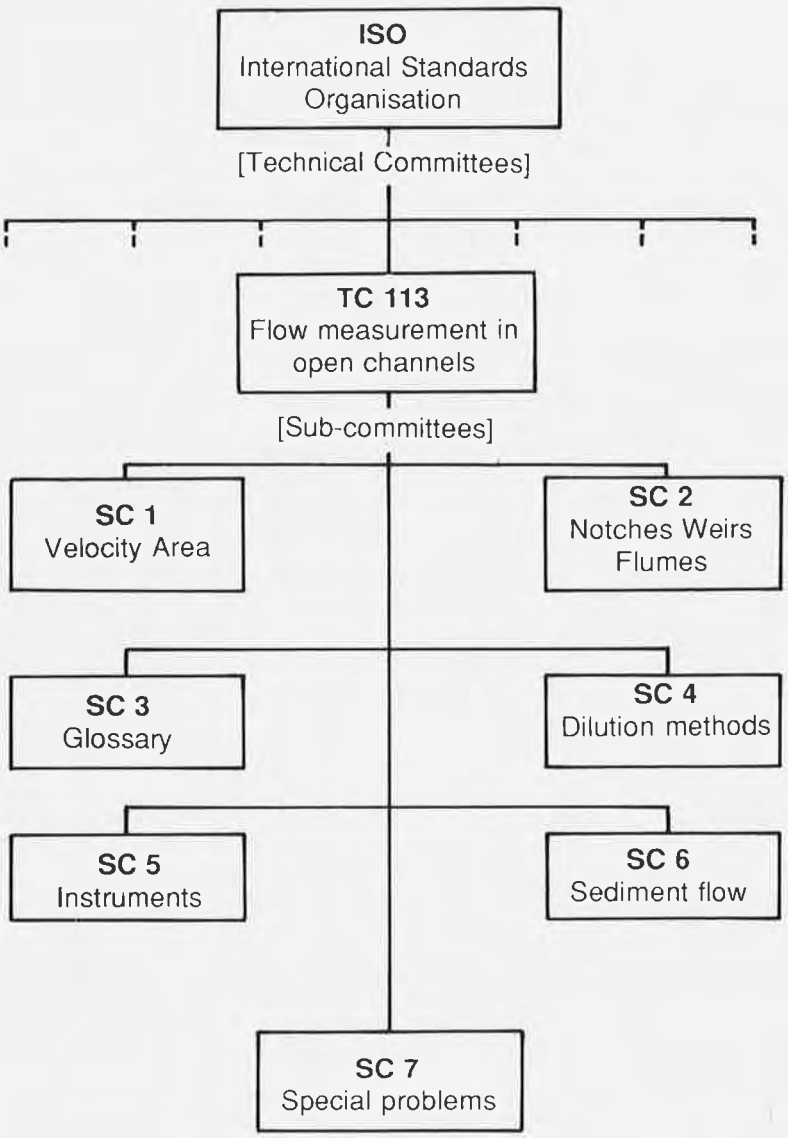
New work is normally identified by the Technical Committee or the Sub-committee but in theory anyone may suggest, or request, new work items. On this basis the Technical Committee would welcome for consideration any subject identified by BHS.

Members of Sub-committees are normally representatives of bodies such as the NRA, Water plcs, Government, Scottish RPBs, universities, IH, HR, consultants and industry, but may also be independent experts in hydrometry or meteorology. Official representatives from BHS would be valued.

Conclusion

The formulation of British standards in flow measurement, groundwater and precipitation has required much dedicated work over the past 30 years. The committee responsible has survived major reorganisations in the water industry during this period and today the use of standards is invaluable in the work of the NRA and the water plcs and also for the benefit of consultants, at home and overseas. Standards are used in monitoring open channel flow and flow in sewers and sewage works and in the regulation and licensing of abstractions and discharges.

For the first time since 1934, when the Inland Water Survey was formed by the then Ministry of Health, one organisation — the NRA — is alone responsible for the hydrometric network in England and Wales. With this important responsibility, British Standards will make a major contribution.



Part of the International Standards Organisation structure

References

Circulation 17, 1988. International Hydrometric Standardisation.

Lees, M. 1985. Inland Water Surveying in the UK: A Short History, *Hydrological Data UK* Yearbook.

Reg Herschy
Chairman, BSI Technical Committee on Flow Measurement of Surface and Ground Water, PCL/3

Honorary fellowship for Australian hydrologist

Professor **David Pilgrim**, Head of the Department of Water Engineering at the University of New South Wales, has been awarded an Honorary Fellowship of the Institution of Engineers, Australia.

This award was for distinguished service to water engineering, illustrated by his contribution to engineering hydrology through the publication *Australian Rainfall and Runoff*.

BOOKS

Contamination in irrigation

Irrigation-Induced Water Quality Problems. What can be learned from the San Joaquin Valley Experience? National Research Council, 1989. National Academy Press, Washington, 157pp, ISBN 0 30904036 1, Price £21.45.

The Kesterson National Wildlife Refuge in California's San Joaquin Valley is at the heart of a valley where a complex of natural habitats and refuge ponds exist alongside areas of irrigated agricultural land. Until about 1978 the water flowing into the ponds was fresh, but then the proportion of irrigation water flow was increased, to become 100% by 1982. These drainage ponds are a closed system: losses are primarily due to evaporative processes. It was anticipated that the typical contaminants associated with irrigation supplies in Mediterranean climate regimes might cause a problem, salinity being the obvious potential culprit.

By 1982 there were reports of environmental damage in the reserve: algal blooms, reduced fish populations, dying waterfowl and reduction in the reproductive rates of the birds. The contaminant responsible was the trace element selenium, which was concentrated to toxic levels by evaporative processes. This was clearly a serious problem for the reserve but also a potential problem in the rest of the valley over a longer period, with the possibility of reduced crop yields affecting production, and implications for public health.

This book has two purposes: to document the history of contamination at Kesterson, which it does in an objective and very readable manner, and to put in context the management solutions sought at Kesterson and to comment on how these procedures would be relevant to other sites and other contamination events, in the wider context of irrigation contaminant management in the USA.

There is no single, simple solution to coping with hydrobiological contamination problems. The committee of authors recognise that the hydrological and agricultural problems may be easier to face, but that the political, social and economic aspects (which all inter-relate) need addressing if the long-term solutions are to be satisfactory. Short-term responses to damage must always be seen as a small part of a long-term strategy for environmental welfare.

Strategies for risk assessment, policy and planning issues that federal and state agencies must address in order to minimise irrigation-induced water quality problems are clearly outlined. There are recommendations to integrate the expertise of scientists, public officials, resource managers and the general public for more effective local response when water quality problems arise. At the national level policies are suggested to minimise the negative impacts of irrigation. Policy makers and programme managers should design monitoring systems capable of detecting degradation of the environment at the earliest possible moment, and state agencies should have the funds to ensure corrections are implemented when problems are spotted.

This book presents a good case study, brings together the threads of the multi-disciplinary problem that is irrigation contamination management, while highlighting the management strategies to approach the problems: a good read.

Pauline Kneale
University of Leeds

British groundwater hydrology

Applied Groundwater Hydrology: A British Perspective. R.A. Downing and W.B. Wilkinson (eds). Clarendon Press, Oxford, 1991, 340pp, £80, hardback.

The aim of this book is to review advances in groundwater hydrology from a British standpoint over the past decade. Forty-one authors representing the British section of the International Association of Hydrogeologists have compiled a most comprehensive survey. The impressive authorship results in a most interesting, valuable and readable book which achieves its objective over a very wide scientific field.

The content of the book is most clearly shown from the 19 chapters with the following (condensed) titles:

(1) Groundwater - the present and future, (2) Legal controls and organisational aspects, (3) Basin management, (4) Rising groundwater levels - an international problem, (5) Recharge and water movement in the unsaturated zone, (6) Shallow groundwater systems, (7) Data collection, storage, retrieval and interpretation, (8) Landfill disposal of wastes, (9) Urban and industrial pollution, (10) Rural and agricultural pollution, (11) Microbiology of aquifers, (12) Aspects of disposal of nuclear waste, (13) Transport in fractured rock, (14) Statistical methods of characterising hydrogeological parameters, (15) Noble gases and radio-elements in groundwaters, (16) Characteristics of groundwater in crystalline rocks, (17) Geothermal energy in the UK, (18) Hydrogeological assessments for underground mines, (19) The international scene - the involvement of British hydrogeologists.

A multi-author review book results in a varied approach with some chapters being of a general nature while others are short, up-to-date works of reference. It is difficult - and subjective - to pick out those on which to comment.

Chapter 4 reviews the problem of rising groundwater and is notable for the excellent review of the situation in London and the likely (and expensive) consequences of a continuing rise of levels. Chapter 6 is a 'heavy', giving a wealth of information on the hydrochemistry of shallow groundwater systems. This chapter provides 110 references (the maximum for one chapter) which makes it a valuable and detailed review.

The chapter on landfill disposal of wastes is well illustrated with many practical and rather horrific examples. A mixture of slow movement of leachate and rapid movement of methane provides the basis for very complex problems and the need for ongoing research and monitoring. The two following chapters are also concerned with pollution - urban and industrial, and rural and agricultural, Both are good with facts, figures and examples.

The chapter on microbiology is very instructive. The variability in bacterial concentration from adjacent samples (by more than an order of magnitude) is rather alarming when judged by the standards of physics and chemistry and it is clear that sample handling and multiple sampling is critical. However, this does not reduce the importance of microbiology in denitrification and the breakdown of organics where bacteria can become 'acclimatised' to pollutants. The most worrying aspect of the chapter comes in the conclusion which states: "Research activity into the microbiology of deep aquifers is now dormant". Surely the state of knowledge has not reached the stage where this should be true?

Two chapters (12 and 13) relate to deep disposal of radioactive wastes and transport in fractured rock. The first is a mixture of philosophy and science with free thinking about the future - the very distant future, almost on a geological time-scale. This review is somewhat dated (based on a 1989 paper) and there has been little fieldwork. This is in sharp contrast with the research on fractured rock where a wealth of fieldwork is quoted.

The chapter on noble gases and radio-elements is a clear dissertation on a difficult subject. A variety of techniques can be applied to estimate the temperature of palæo-recharge water, to estimate mixing of water bodies and to identify nitrate reduction.

The final chapter reviews the activities of UK researchers and consulting engineers throughout the world. A message which comes from

several projects concerns the competition between domestic, industrial and irrigation uses of scarce water and the problems of over-exploitation which are arising where there is a lack of overall control.

Each chapter has a list of references which results in some overlap – not surprising when there is a total of nearly 900 references. The book is very well produced, well illustrated and pleasingly free from proof-reading errors. Unlike some review books, the cover is very comprehensive and it avoids any problem of being 'bitty' or discontinuous. It is likely to act as a reference work until, maybe, a repeat version appears in another decade.

One subject which is not touched upon is that of groundwater temperature (other than geothermal). It is surprising that there is no notable research using an easily measured variable with application to groundwater mixing and movement.

Overall, a book to be recommended as excellent and informative reading and one for the permanent bookshelf where it can be used to provide a lead-in to a wide range of subjects. Both editors and authors are to be congratulated on its production.

D B Smith
Wantage

African development conference

Techniques for Environmentally Sound Water Resources Development.
R. Wooldridge (ed.), Pentech Press, London, 1991, 332pp, £42.00 hardback.

The contents of this book are not quite as wide-ranging as its title would imply. It consists of 25 papers delivered at the African Regional Symposium organised by Hydraulics Research Ltd, UK and the Egyptian Water Research Centre in February 1991. All but three of these papers are primarily concerned with the African Situation.

Unfortunately, the four invited theme lectures and a digest of the technical session are to be contained in a separate volume, which is a pity because it means that the current volume lacks thematic structure and any form of overview. The brief, one-and-a-half page preface clarifies the organisation of the conference but is no substitute for a technical summary (It is interesting to be told that the papers have been printed in the alphabetical order of the surname of the senior author, but this only serves to underline the lack of meaningful editorial coverage.) If only the papers had been grouped together according to subject matter, this would to some extent have mitigated the reader's problems.

Even allowing for this lack of organisation, however, one is left with the impression that the field is very much in its infancy — loosely integrated, methodologically vague in many respects and frequently hampered by lack of data and even of relevant scientific theory. This is not so much a criticism of the authors, many of whom are devoting great effort to remedying the situation. Rather, it is an indication that the field must be a priority area for research and development and that this conference, like the IAHS session in Vienna later last year on ecologically-sound development, was timely and is likely to stimulate and open up an important new area of interdisciplinary collaboration.

One notable feature of the book is the number of joint Anglo-African papers — seven in all — which seems to be a healthy indication that technology transfer is working. Understandably, irrigation is the dominant concern, accounting for eight of the contributions, followed by human health (generally linked with the effects of irrigation) accounting for five more. Only four papers are concerned with techniques of impact assessment (EIA).

The emphasis throughout is on rapid, simple, cheap, low-tech. methods that are affordable and manageable for developing countries with little data available for either baseline or impact studies as well as limited funds and expertise. Even in the field of assessing and predicting health impacts, this often amounts to a strong reliance on simple questionnaires presented to managers of irrigation projects or village elders. A major conclusion of one such questionnaire test is that teachers should also be targeted, since they are likely to have a better idea of children's health problems.

Despite years of research into tropical medicine, there seems to be been a distinct lack of research into environmental aspects. This is now making it very difficult to respond on the basis of scientific theory to the demands being urgently placed upon it to predict the effects of environmental change. In this respect, the major programme funded in 1990 by the British Overseas Development Administration at Liverpool School of Tropical Medicine and the guidelines produced by the WHO/FAO/UNEP Panel of Experts on Environmental Management published in 1989, both outlined here in Birley's paper, are to be welcomed as important initiatives.

As individual case studies, most of the papers contain useful material, ranging from more efficient irrigation methods, such as pitcher or pipeline irrigation, to methods of increasing the water available for irrigation by judicious mixing and re-use of drainage water or by the use of treated sewage. A number document failures. Others appear to document successes, although there may be political reasons behind some of these claims. Overall, the book should be seen as a valuable contribution to a new and pressing field of environmental research, in which both scientific theory and operational methodology are likely to make great advances in coming years.

J.A.A. Jones
University of Wales, Aberystwyth

Hydrological modelling

Hydrological models for water-resources system design and operation. A. Becker and P. Serban, Operational Hydrology Report No. 34. World Meteorological Organization, Geneva, WMO-No.740, 1990, 80pp, paperback.

This booklet is the latest in a line of WMO publications aimed at facilitating technology transfer around the world. Although the main text barely covers 40 pages, the appendices are as important a part of the aim as the text. Whereas the text provides an overview of the current state of the art, discussing the advantages and limitations of different approaches to modelling, appropriate criteria for selecting models for particular applications, and reviewing current trends in requirements and in technology, the ten annexes provide a practical guide to available programs.

Although most models are still primarily for research use, the practical guide is deliberately limited to models available for applied use, either in long-term planning and design of water resource systems and hydraulic structures for real-time forecasting. This is based largely upon the WMO Hydrological Operational Multipurpose Subprogramme (HOMS) Reference Manual (1988) or models available for exchange through WMO, but it is significantly augmented by an evaluation of models trawled in surveys by Regional Associations, especially the European, and by the US congress Office of Technology Assessment. The tabulated lists categoris e the models in terms of purpose, type of system, the output variable, the degree of causality and the form of spatial discretization. The text provides a full discussion of the principles used in the classification.

Admirable though this guide is, the evaluation of models is implicitly misrepresented. According to the text, models are rated on their *reliability*, i.e. the accuracy with which the processes covered are described in the algorithm, and *credibility* of the results. Evaluation ranged from "supplied information is generally unsatisfactory", through "model does an adequate job for most purposes" to "at the current state-of-the-art does a good job". However, the text does not make clear that this evaluation is only listed for general

categories of model, not for individual models and, moreover, that the evaluation is that of the US OTA published ten years ago!

As a guide to approaches to modelling, the text does an excellent job in just 40 pages. There is a good discussion of the desirability of deterministic physically-based models, and of the question of balance between deterministic and probabilistic elements. The problems of extension to larger scale are also well presented, together with a clear discussion of the problems of time and space discretization in relation to spatial and temporal variability in parameters and variables. Good use is made of tables and diagrams to summarise and illustrate, and they play an important part in creating a very clear and succinct introduction to the subject. It is unfortunate that WMO was not able to convert the many hand-drawn diagrams into diagrams of the quality normally expected in modern, western publications but this should not detract from the fact that the authors have produced an approachable, authoritative and instructive text.

J.A.A. Jones
University of Wales, Aberystwyth

Measuring sediment transport

Manual on Operational Methods for the Measurement of Sediment Transport Long Yuqian, 1989. (World Meteorological Organization Operational Hydrology Report No. 29: WMO No. 686). World Meteorological Organization, Geneva. 169pp. ISBN 92 63 10686 X.

Sediment yield, sediment transport, erosion and deposition are all of long-established concern to water resource scientists and engineers, land managers and soil conservationists, yet many difficulties remain in sediment transport measurement. Long Yuqian has tackled the problems squarely and directly in this manual, reviewing the measurement of suspended sediment, bed load, total sediment discharge, and erosion and deposition in reservoirs and channels as well as laboratory, data processing and reliability assessment procedures in successive chapters.

The long Chinese experience of sediment monitoring in large rivers is used to the full, along with information from USGS and IAHS publications. However, this leads to occasional lack of clarity about the scale of the measurement or sampling scheme being discussed. Surveying the sedimentation of the Sanmenxia Reservoir on the Yellow River, just above where it enters the North China plain, is quite different proposition from studying a small Pennine reservoir. Equally, the superb detailed observations on the River Creedy in Devon by Walling and his colleagues, appropriately discussed in this manual, are very different in scale from those needed on the Changjiang (Yangtse River) at Yichang.

A good discussion of suspended sediment sampling methods pays attention to cross-section variations in particle-size distributions in large rivers and rightly insists on the importance of calibration of samplers, noting for example that a relationship between suspended sediment concentration and a photodensity turbidity reading can only be established if the grain size is relatively constant.

Pumping samplers, so widely used in the UK, are seen as useful in small rivers and experimental catchments, particularly in remote areas. Bed load sampling is discussed thoroughly, with consideration of a variety of samplers and of empirical predictions based on bed material and suspended sediment particle size distribution. Channel armouring and coarse gravel sampling are recognized as problems, but the manual merely says research into sampling methods is needed. The important work on gravel-bed rivers by Hey, Thorne and others is not discussed.

Sediment is a pollution carrier and Long Yuqian recommends that sediment sampling programmes should involve analysis of 12 samples per year for sediment quality at the beginning of a programme, with adjustment of sampling frequency later to facilitate evaluation of total contaminant transport. Where episodic discharges occur, such as overflows from combined sewers, as discussed in the UK by Lester, Crabtree, Brownbill and others, much more frequent, event-based sampling would be needed. The analyses discussed do not include the oxygen demanding character of sediments, which is generally important in areas affected by sewerage spills.

Overall, the manual emphasises how the measurement of sediment discharge, the bed load in particular, is relatively crude compared with the well-established methods for stream gauging. Sediment in the unsampled zone, below the lowest point captured by suspended sediment samplers, requires special attention. The manual will help those concerned in improving sediment transport measurement. For those familiar with the English literature, the information on Chinese practice is most valuable. For beginners in the field, this manual is a good introduction with much sound advice. Other works will have to be consulted, however, and the bibliography, while excellent on national manuals and USGS works, omits much important hydrological and geomorphological literature on sediment transport technology.

Ian Douglas
University of Manchester

Publications from IH & IAHS

Three new volumes in the Institute of Hydrology Report Series have recently been published, each costing £15.

Reservoir flood estimation: another look (Report No. 114) summarises a study funded by the Department of the Environment, providing extensive comparisons of design floods for 15 reservoired catchments in the UK. It explores the sensitivity of reservoir flood estimates to the precise storm duration assumed, compares 'summer' and 'winter' values of the Probable Maximum Flood and considers snowmelt allowances and use of local data.

Estimating contaminant loads in rivers (Report No. 117) reviews river mass load estimation procedures for the wide range of hydrological conditions throughout the UK. Reliable information on contaminant loads carried by rivers is increasingly important for environmental assessment and water management, and a computational framework is presented.

Catchment classification for hydrological parameter estimation (Report No. 118) looks at ways of estimating hydrological parameters at ungauged catchments. An alternative to regression equations is to use catchment classification to compare them with similar gauged catchments. The methods for estimating the unit hydrograph time-to-peak and standard percentage runoff are evaluated for 99 UK catchments.

A free publication with the title **Improved Irrigation Efficiency using Soil Physical Techniques** summarises the results of a study of drip-irrigation of sugar-cane in Mauritius. Tensiometer arrays were used to measure soil moisture, leading to an understanding of processes and the concept of 'soil water status'. The techniques developed are applicable to other crops, soils and climates.

The IAHS Press has published the proceedings of an international symposium in St Petersburg in 1990 entitled **Glaciers-Ocean-Atmosphere Interactions (IAHS Publication No. 208)**. It includes more than 50 papers over 550 pages and considers fundamental questions of interactions which are of great importance to global change processes. It costs $60 and is available from the IAHS Press at the Institute of Hydrology address.

Hydrology Courses

LOW RIVER FLOWS

Methods of estimating low river flows including the use of manual and computer based techniques.

20 - 23 July 1992
Tadley Court, Basingstoke

Residential course
£790 + VAT

THE FLOOD STUDIES REPORT

Flood estimation based on practical interpretation of the Flood Studies Report.

21 - 25 September 1992
Tadley Court, Basingstoke

Residential course
£790 + VAT

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For details of these and other hydrology and water related courses, please contact:

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New Members

We welcome the following new members to the Society:

Abes, B. ..... Water Resources Research Group, Salford University
Aspinwall, S.J. ..... NRA Yorkshire Region, Leeds
Bates, P.D. ..... Department of Geography, University of Bristol
Beckwith, C.W. ..... Keyworth, Nottingham
Dwyer, I.J. ..... Institute of Hydrology, Wallingford
Fellowes, N.M. ..... Bideford, Devon
Lillywhite, D.J. ..... Bickleigh, Devon
Lumbroso, D.M. ..... Southampton
MacKenzie, N.D. ..... Geology Department, University of Exeter
Moxham, D.J. ..... Bath, Avon
Templeman, Dr R.F. ..... Garsdale, Cumbria
Wall, A.B. ..... Bath, Avon
Witwit, W.A.H. ..... London
Yener, A.G. ..... London

Obituary:

Richard B Bulman CEng FICE

It is with sincere regret that we announce the sudden death in January of Richard Bulman.

Richard, latterly an independent consultant based at Cumwhinton near Carlisle, was a long-standing member of BHS. He was also a founder member of the Pennines Hydrological Group and was active in the Northern Counties Association of the ICE.

Members of the Pennines Hydrological Group will particularly remember Richard as a regular attender at meetings and as an, often vociferous, contributor to AGMs.

Our sympathy is extended to Richard's widow, Ruth, and her family.

Appointment of National Correspondents for two IAHS Committees

In response to the call for nominations in *Circulation 33*, **Dr Jim Shuttleworth** (Institute of Hydrology) has been appointed as the new National Correspondent to the International Committee on Atmosphere-Soil-Vegetation Relations (ICASVR).

D B Smith (who recently retired from the Institute of Hydrology) has been appointed to serve as National Correspondent to the International Committee on Tracers, which deals with the application of tracers to all aspects of the hydrological cycle.

News from Members

Midlands Section News

The Midlands Section jointly promoted an evening meeting with the East Midlands Branch of IWEM entitled 'Drought - two years' experiences - two perspectives'. The meeting was held on 12 February at the Willoughby Lodge, Nether Broughton. The two perspectives were presented by **Gordon Davies** of the NRA (Severn Trent Region) and **Richard Douglas** (Severn Trent Water). The title of the presentation had almost been overtaken by the continuation of the drought into a third year.

Gordon illustrated his talk by reference to the statistics of rainfall and river flow across the Severn Trent Region. Richard made use of the control curves for several of the East Midlands reservoirs to contrast the droughts, and the consequent response of Severn Trent Water. The significance of the Carsington scheme in enhancing both yield and flexibility was also illustrated.

By way of reactivation of the Midlands Section, a business meeting was convened at the University of Birmingham on 26 February 1992. This was attended by 18 members and prospective members. It provided an opportunity to discuss the future activities of the Midlands Section, particularly the preferred frequency and content of future meetings.

The consensus was that a frequency of about four meetings per year was acceptable, and subjects for meetings were discussed. These included a range of water resource issues, such as water grids and surface-groundwater interaction. Other subjects discussed included remote sensing and hydrology, water quality issues and enhanced contact with the Institute of Hydrology.

The compilation of a suitable programme of meetings was entrusted to a meetings sub-committee comprising **Richard Douglas, Geoff Petts, David Mitchell** and **Paul Webster**. This sub-committee has subsequently met and is currently putting together a programme of meetings for the next 12 months. Details of some of the planned meetings are included with this issue of *Circulation*. The meeting was followed by a presentation by Paul Webster entitled 'River basin planning in China - a case study'. The presentation, illustrated by slides, described a project in which Paul participated while employed by Mott MacDonald.

Members on the move

Since 1985 **James Bathurst** has been on long-term secondment from the Institute of Hydrology to the NERC Water Resource Systems Research Unit in the Department of Civil Engineering, University of Newcastle upon Tyne. Following the recent completion of the NERC period of funding for the Unit, he has decided to stay in Newcastle and has joined the University as a Principal Research Officer.

James will continue to work within the Unit (which continues life with a staff of 14 and a range of projects funded from research council, government, EC and industry sources). His particular research interests are in catchment sediment yield modelling and mountain river dynamics.

The National Rivers Authority - Europe's strongest environmental agency - is responsible for fisheries, conservation, water resources and flood defence in England and Wales. We currently require two water professionals to join our Regional Headquarters in Peterborough - a lively and expanding city with excellent facilities and communication links.

NRA

Anglian Region

Hydrologist £16,608 - £20,607 + benefits

Your main activity will be to carry out investigations for regional water resources studies, involving the analysis of hydrometric data and the use of mathematical models. Depending on the level of your experience, you may also contribute to the design of the hydrometric network, the development of data processing systems and the provision of flood forecasting facilities.

You should be experienced in applied hydrology and possess relevant qualifications. In addition to sound technical knowledge you should have an aptitude for the use of hydrological analysis software, mathematical models and data processing packages. You must also enjoy working on your own initiative, be an able communicator both orally and in writing, and have the necessary skills to manage a small team. The ability to liaise effectively with colleagues throughout the country is essential.

For an informal discussion contact Nigel Fawthrop, Principal Hydrologist, on 0733 371811 ext 4224.

Water Resources Technician £10,572 - £13,584 + benefits

In this varied role, you will assist with the collection, processing and evaluation of data in connection with all aspects of water resources planning and management.

You should have a numerate degree and be competent in the use of computers. Some relevant experience is desirable as well as an understanding of hydrology or hydrogeology, but most important is a high level of enthusiasm, initiative and common sense. Although this role is largely office-based, a clean driving licence would be an advantage.

For an informal discussion contact Julie Barker, Senior Engineer, on 0733 371811 ext 4409.

For both positions we are willing to be flexible about the start date. Starting salaries depend on qualifications and experience.

Application forms and full job descriptions are available from the Personnel Department, National Rivers Authority, Anglian Region, Kingfisher House, Goldhay Way, Orton Goldhay, Peterborough PE2 0ZR. Telephone (0733) 394289.

The closing date for the receipt of applications is 15 June 1992. Interviews will be held week commencing 29 June.

NRA is an Equal Opportunities employer.

Questionnaire results

Rod Hawnt has been analysing the responses to the questionnaire sent to BHS members last year. A fuller report will be printed in the next *Circulation*, but here are a few interim results:

There were 358 replies, 32 from overseas and only 17 from students.

Of those who replied, 120 had a first degree in Civil Engineering and 115 in Geography. The main categories of employment were Academic (84), Consultant (80), NRA (59) and Water industry (59). Only one was a hydrogeologist, although many declared an interest in groundwater.

The frequency and content of *Circulation* were endorsed by a large majority; some wanted more technical articles (64), a few wanted more lighthearted articles, but 251 said that the balance was about right. Finally, more than 50 said that they would like to contribute in some way: we look forward to hearing from you!

Apology

On page three of *Circulation 33*, the origin of the diagram of hydropower capacity was not acknowledged.

This figure was reproduced from Richard Hackett's MSc dissertation at the University of Newcastle upon Tyne, but originated in a study undertaken by Salford University Civil Engineering Ltd in 1989 and published by ETSU.

We apologise for this omission and ask authors to acknowledge their sources in future.

FORTHCOMING EVENTS

Meetings

4th Disaster Prevention & Limitation Conference
EUROPEAN and INTERNATIONAL DIMENSIONS of ENVIRONMENTAL DISASTERS
Bradford, UK
8 – 10 September 1992

This conference is devoted to the prevention and mitigation of natural and man-made disasters, including the effect of pollutin on people and their environment.

Details may be obtained from Dr A Z Keller, Disaster Prevention & Limitation Unit, University of Bradford, Bradford, West Yorkshire, BD7 1DP. (*Tel:* 0274 384237, *Fax:* 0274 391333)

EUROPEAN NETWORK OF EXPERIMENTAL AND REPRESENTATIVE BASINS (ERB)
4th General Assembly & Conference
METHODS OF HYDROLOGIC BASIN COMPARISON
Oxford, UK
29 September – 2 October 1992

The ERB General Assembly will be held on the first day, followed by a two-day conference and a one-day field trip.

The conference, organised by the ERB Committee and the Institute of Hydrology and co-sponsored by IAHS, will focus on the methods of hydrological comparison and regionalisation used in basin studies. It is hoped that papers will be submitted to the *Journal of Hydrological Sciences* for publication after the meeting, incorporating any useful comments arising at the meeting.

A subsequent ERB meeting will be devoted to the results of such comparisons.

Details may be obtained from Dr Mark Robinson at the Institute of Hydrology, Wallingford.

Symposium on
ENGINEERING in the UNCERTAINTY of CLIMATIC CHANGE
London, UK
28 October 1992

This symposium organised by the Institution of Civil Engineers addresses the consequences for engineers of the greenhouse effect and resulting climatic changes, in particular, what actions should be taken now.

Sessions will include: Scenarios of Climate Change, Water Resources and Water Supply, Maritime Engineering, Energy Production, and Geotechnics.

Invited speakers include: Sir Crispin Tickell, Prof Peter Stott, Dr John Houghton, Prof Brian Wilkinson, Dr Brian McCartney.

Furhter details: The conference Office, ICE, 1 Great George Street, London SW1P 3AA

International Conference on
PROTECTING THE NORTH SEA
—Practical steps to control and treat wastewaters
10-12 November 1992
Sheraton Hotel, Brussels

Further details from: The Conference Office, ICE, 1 Great George Street, London SW1P 3AA. Co-sponsors: European Institute for Water, European Water Pollution Control Association, International Assn on Water Pollution Research & Control, WRc.

EUROPEAN ASSOCIATION OF REMOTE SENSING LABORATORIES
Workshop on
The Use of Remote Sensing in Hydrology: Runoff Prediction Models
Enschede, The Netherlands
5-7 October 1992

The objectives of the meeting are to consider the uses of remote sensing for hydrologists, to bridge the operational/research gap and to address the issues of data collection and delivery, existing hydrological remote sensing models and water and sediment transport processes.

As well as keynote and contributed papers, a significant proportion of the time will be devoted to discussion.

Up until the end of July, registration costs 1200 FFr, with reduced rates for EARSeL members and students.

Details are available from Mme Godefroy at the EARSeL Secretariat, B.P. 209, F-92108 Boulogne-Billancourt.

INTERNATIONAL SYMPOSIUM ON ENGINEERING HYDROLOGY
to be held in conjunction with 1993 National Conference on Hydraulic Engineering, ASCE
San Francisco, California
25-30 July 1993

The theme for the meeting is "Natural disaster reduction through hydraulic and hydrologic engineering", with special emphasis on engineering applications to practical problems of engineering design and analysis, bridging the gap between theory and practice. Topics include:
• Wetland hydrology • Hydrology in coastal environment • Hydrology in arid and semi-arid regions • Drought • Urban stormwater management

• Frequency analysis and extreme events • Irrigation and drainage • Global climate change • Minimum streamflow/habitat • Design storm hydrographs • Application of GIS •Real time flood forecast • Karst hydrology • Snowmelt & floods • Flash floods in mountain areas • Interrelation of surface and groundwater • Hydrologic aspects of water quality • Water demand and supply • Groundwater flow and pollutant transport • Technical information transfer to developing countries and engineering community • Debris flow modelling

Abstracts should be no more than two pages double-spaced and submitted by **15 October 1992.**

Abstracts to:
Dr Chin Y. Kuo
Dept of Civil Engineering
212 Sackett Building
The Pennsylvania State University
University Park, PA 16802, USA

General information:
Dr S. T. Su
Tudor Engineering Company
P O Box 23210, Oakland, CA 94623, USA

INTERNATIONAL SYMPOSIUM ON SEASONAL AND LONG-TERM FLUCTUATIONS OF NIVAL AND GLACIAL PROCESSES IN MOUNTAINS AT DIFFERENT SCALES OF ANALYSIS
Tashkent, Uzbekistan
20-26 July 1993

Organised by the USSR IHP National Committee, UNESCO and the IAHS, the theme for this meeting, within the IHP-IV H-4-1 and H-4-2 projects, is "The Role of Snow and Ice in the Global Water Cycle".

This topic is clearly of great value in assessing and forecasting water resources, but integrated study of snow and glaciers on all scales from the local area to the hemisphere is important for the study of global climate fluctuations.

Symposium tours to mountains and glaciers of the region have also been organised.

To receive further information, contact Dr V G Konovalov, Central Asian Regional Research, Hydrometeorological Institute, 72 Observatorskaya str., Tashkent, USSR 700052 (*Tel:* 35 40 72, *Telex:* 116127 SNEG or 116033 OBLAKO).

Fourth BHS National Hydrology Symposium

Cardiff University, 13–16 September 1993

This one you must not miss! Themes focus on the 'hot' issues for hydrology in 1993, including sustainability, water quality, land use and climate change effects. Full details will be in the next *Circulation*. Impatient authors with ideas for papers should please contact Jim Blackie at the Institute of Hydrology, Wallingford, OX10 8BB; telephone 0491 38800; fax 0491 32256.

Diary

3rd June 1992
BHS National Meeting
"Consulting overseas" (see *Circ. 33*).
Contact: Dr Richard Harpin
(*Tel:* 0734 812479 *Fax:* 0734 812089)

24th-27th June 1992
BHS/Scottish Hydrological Group/ British Dam Society/IWEM conference "Water resources and reservoir engineering," Stirling (see *Circ. 33*).
Contact: Dr Susan Walker, NRA North West Region, P.O. Box 12, Warrington, WA4 1HG (*Tel:* 0925 628425, *Fax:* 0925 415961).

14th June 1992
Geol. Soc. Hydrogeological Group
"Karst hydrology – recent developments"
Venue: University of Leeds
Contact: Darminder Chadha, NRA Yorkshire Region (*Tel:* 0532 440191)

3rd-5th September 1992
Assn Brit. Climatologists Summer Meeting:"Precipitation: causes, characteristics & consequences"
Venue: St David's College, Lampeter
Contact: Sue Postle (Tel: 071-276 8297)

7th-11th September 1992
2nd International Conference on Hydrological Applications of Weather Radar
Venue: Hannover, Germany
Contact: Prof Ian Cluckie, University of Salford M5 4WT (*Tel:* 061-745 5036)

15th-16th September 1992
Drought Workshop
Venue: Loughborough University
Contacts: Prof Geoff Petts, Department of Geography, Loughborough University (*Tel:* 0509 222791) & Dr John Mawdsley, NRA Northumbrian Region, Eldon House, Regent Square, Gosforth, NE1 7RU (*Tel:* 091-213 0266)

15th-16th September 1992
BHS Welsh Section – AGM
"Modelling the River Severn floods"
Venue: UWCC, Cardiff
Contact: Linda Aucott, NRA Wessex Region, Rivers House, East Quay, Bridgwater, TA6 4YS (*Tel:* 0278 457333)

21st September 1992
BHS National Meeting
"Preferential Transport of Sediments and Solutes from Uplands to Estuaries"
Venue: University of Leeds
Contact: Dr James Bathurst, Department of Civil Engineering, University of Newcastle upon Tyne (*Tel:* 091-222 6333, *Fax:* 091-222 6669).

21st September 1992
ORSTOM
"Régionalisation en hydrologie: application au développement"
Venue: Montpellier, France (in French)
Contact: Luc Le Barbe, Centre ORSTOM, B.P. 5045, F-34032 Montpellier-Cédex 1

Copy Deadline for Issue No. 35
3rd July 1992

*** We prefer to receive articles as word processed files on disk.**

Circulation is the quarterly newsletter of the British Hydrological Society. It is issued free to members, but is also available on an annual subscription of £18. All enquiries concerning membership should be made to Peter Bacos, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA. Telephone 071 222 7722. Please address all other correspondence to the Editor, Celia Kirby, Institute of Hydrology, Wallingford, OX10 8BB. Telephone: 0491 38800 extension 2360. Fax: 0491 32256.