

Circulation

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The Newsletter of the British Hydrological Society

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President's Perspective

It was a very busy day for me yesterday, with the opening of COP27, and the subsequent media enquiries. I spent quite a few hours talking to various radio shows, culminating in Sky News in the evening. It was on 5Live yesterday morning that I first heard about the seasonal forecast from the UK Met Office that was released yesterday – for severe flooding in the UK in Feb 2023 – as a direct result of La Nina conditions in the Pacific, the 3rd consecutive La Nina year. If the forecast becomes reality then this is at odds with the drought conditions we are still experiencing in most of the UK in November 2022: despite the rainfall over the last couple of months, due to very dry soils, reservoirs have not filled that much. However, it is consistent with the type of climate conditions that models project for the future, with hotter, drier summers, interspersed with frequent intense downbursts and followed by wetter, windier winters. Of course the question is how we can manage this increased variability, with drier catchments having an effect on both water quality (flushing events, waste water problems, sediment, dilution, etc.) and flood inundation itself.

These types of issues and more were discussed at the BHS Symposium in September which was attended by over 200 people. It was fantastic to meet people in person again and to be able to discuss and contest facts and opinions – thanks so much to Nick Chappell and the team at Lancaster University for providing us with such a great conference. It reminded me of what a dynamic, vibrant and creative community of hydrologists we have in the UK, and the fact that we must re-start our in-person meetings. The main BHS Committee are planning quite a few starting in the New Year – so watch this space and please sign up! This will culminate in a 40th anniversary event in November 2023 – yes the BHS really is 40 years old next year!

One thing we did note about the BHS Symposium was the lack of early career scientists and practitioners. Perhaps this was simply timing, as the Peter Wolf Symposium was the week afterwards – and was very well attended, being sold out before registration closed – thanks so much to Chris White and the rest of the organizing committee for running this popular event. If you do have ideas though, it would be great to hear how we can attract more early-career hydrologists to the BHS Symposium. We are planning to hold a dedicated early-career day at the next Symposium, and in general we are looking at EDI issues across the BHS membership and in meeting planning, etc., within the Main Committee. A page of Circulation will be dedicated to EDI from the next issue.

In other updates, as BHS President I am on the Governance Board of the Flood Hydrology Roadmap, which is gaining momentum, and we will be interviewing for membership of the Scientific and

Technical Advisory Group (STAG) over the next few weeks. This is an exciting time to be involved in UK flood hydrology, as we heard at the BHS Symposium, with both the Roadmap and the Flood and Droughts Research Infrastructure Programme providing momentum and funded research opportunities. This really is a 'once in a generation community opportunity', so I encourage everyone to get involved where you can.

Finally, I would like to thank again those people who have served on the BHS Main Committee and finished their term in September 2022 – Nick Chappell, Liz Lewis, Michael Vaughan, Anita Asadullah, Michael Pollock, and David Boorman – and thanks to Lucy Barker for completing her term as Hon Sec (she remains on the Committee as UKCEH Representative). We couldn't do it without you all as volunteers so thanks for keeping the Society alive and active. And thanks also to all those new Committee members – Duncan Faulkner (President Elect), Victoria Coates (Hon Sec), Katy Peat, Gemma Coxon and Will Rust – I look forward to working with you over the next 2 years until my term ends. Thanks also to Celia Kirby to whom I was delighted to present the first BHS Lifetime Achievement Award for her consistent and longstanding support to the Society. Finally, thanks to everyone I have not mentioned who works so hard on the Committee and for the Society to deliver meetings, our webinars, publications, website, etc. You know who you are! Hopefully our new and upcoming governance plans will allow even more members to get involved in different aspects of the BHS, creating an even better and even more inclusive Society as we enter our 40th year.

Hayley Fowler
BHS President



40th Annual General Meeting
13th September 2022
held at Lancaster University

A full report of this meeting will be in the next issue of Circulation. In the meantime, it is with great pleasure that we introduce some important changes to the Committe.

Duncan Faulkner, President Elect


Duncan in the Lakes earlier this year

Duncan is Chief Hydrologist at JBA Consulting, where he has worked for 23 years, following five years at the Institute of Hydrology (now UKCEH). He is keen on bringing academic advances into the work done by practitioners. His main specialism is flood hydrology, which dates back to his involvement in the FEH research programme. He is fascinated by groundwater, karst, reservoirs and pumped catchments. Another obsession is the importance of understanding physical processes before attempting to model anything, which perhaps reflects the remnants of his knowledge from a physics degree. He has worked on projects in the UK, Ireland, Australia, Canada, south-east Asia, the Middle East and, currently, developing countries in Africa. These have covered a wide variety of scales from quarries up to continents. One aspect that he enjoys is the challenge of communicating hydrology to practitioners, regulators, lawyers and anyone else who will listen. This has involved activities as diverse as writing journal papers, being cross-examined by barristers and surprising delegates in training courses by presenting them with sponges, soil and dice. Outside work Duncan is typically found building fences, planting trees, growing vegetables, singing in choirs, editing a magazine and trying to put his faith into practice. He values learning from failures and mistakes, which is just as well as he produces plenty of both.

Victoria Coates, Hon. Secretary


Victoria on holiday in Costa Rica

Victoria Coates is a Flood Modeller at Mott MacDonald and has five years' experience in the water and environmental management sector. Her main interests involve trying to reduce flood risk through sustainable soil and land management. She is currently seconded into the Environment Agency and working on a large strategic project in the Great Ouse catchment. At Mott MacDonald, Victoria is the office champion for the Brilliant Neighbours Initiative, which aims to encourage staff to take action against the climate emergency in their local community. So far this has included setting up a monthly litter

pick around the office. In the future, she hopes to set up a project to work with local schools, to help them create sustainable urban drainage systems to reduce their flood risk. In her spare time, she loves to be outdoors and enjoys playing or watching sport.



Gemma Coxon, Committee member

Dr Gemma Coxon is a Senior Lecturer in Hydrology at the University of Bristol and a UKRI Future Leaders Fellow. Her research focusses on understanding and predicting floods and droughts in changing environments through the simulation of water systems from local to continental scales. She is the lead developer of DECIPHeR, a novel catchment to continental scale flexible distributed hydrological model that has been widely used for hydrological projections across the UK. She leads numerous UK community efforts in hydrology including the first, open-access national catchment dataset for Great Britain (CAMELS-GB) and as the capacity building lead for the UK Flood and Drought Research Infrastructure project. In her spare time, Gemma has been building a house as part of a self-build eco-development in North Bristol and finally moved into the house in May!

William Rust, Committee member

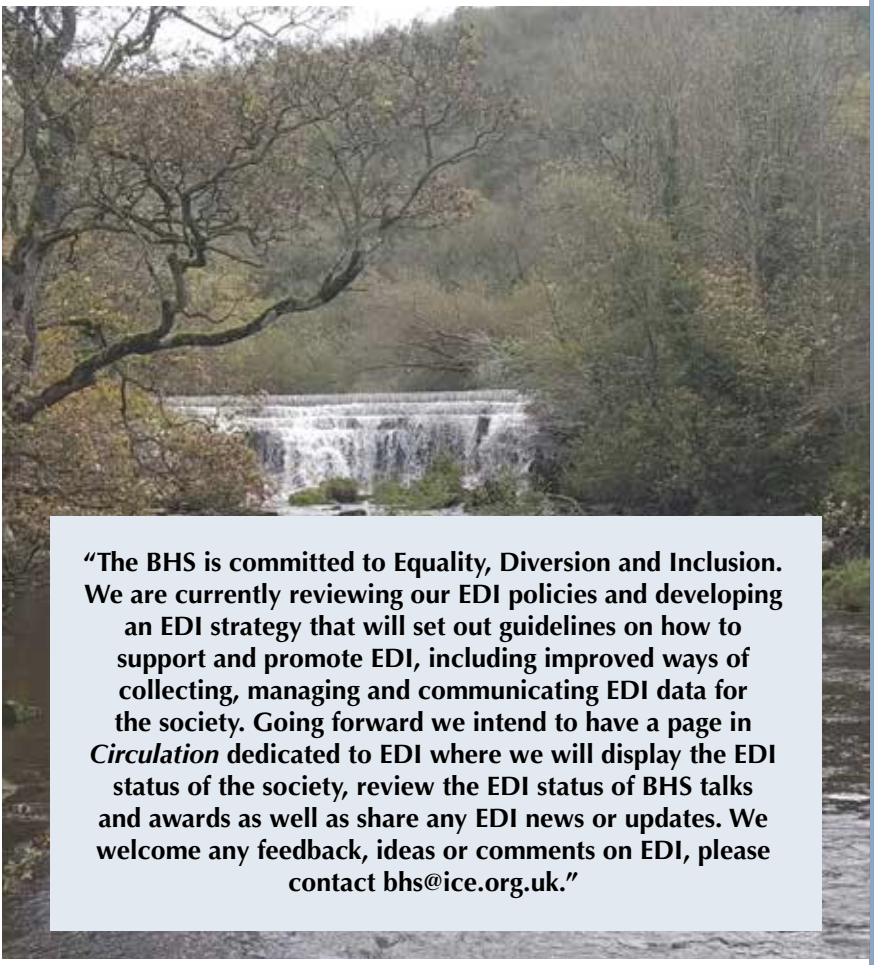
My interests are split between high-flow hydrology including flood risk, and long-term climate system impacts on water resource behaviours. For the past 10 years, I have been working on flood risk interventions across the UK and globally, with a focus on flood dynamics between multiple sources and in developing integrated modelling tools to address these complex issues. Second to this, I have been leading research into the effects of climate oscillations, such as the North Atlantic Oscillation, on UK water resources and how this can produce hidden behaviours that we may leverage for improved water resource management. In my personal time, I enjoy painting, DIY and video games.



Katy Peat, Committee member



Katy is Head of Adaptation Science at Defra, including the research underpinning the next UK climate change risk assessment (CCRA4), climate services using UKCP18 and a framework for adaptation research and innovation to support the forthcoming third UK national adaptation programme (NAP3). She provides scientific expertise on the latest climate adaptation science, advising on and shaping the Met Office Hadley Climate Centre Programme and the UK Climate Resilience Programme, as well as maintaining links with senior scientists and climate experts across government.



"The BHS is committed to Equality, Diversion and Inclusion. We are currently reviewing our EDI policies and developing an EDI strategy that will set out guidelines on how to support and promote EDI, including improved ways of collecting, managing and communicating EDI data for the society. Going forward we intend to have a page in *Circulation* dedicated to EDI where we will display the EDI status of the society, review the EDI status of BHS talks and awards as well as share any EDI news or updates. We welcome any feedback, ideas or comments on EDI, please contact bhs@ice.org.uk."

The 2022 UK DROUGHT – a preliminary appraisal

With a temperate climate and being adjacent to the Atlantic Ocean, the UK is rarely afflicted by drought intensities common in more arid environments. However, our resilience to drought in a warming world has been severely tested through the spring and summer of 2022. Following near-average UK precipitation over the last winter, a major synoptic change heralded the development of a drought which intensified rapidly over the March-August period. Almost all of the country – and much of Europe – was impacted by the drought but its spatial severity varied substantially. For England & Wales, the record temperatures, meagre rainfall, increased evaporative demands and arid soil conditions contributed to one of the most extreme 6-month droughts on record. In a warming world such events are is likely to occur with greater frequency with pervasive water supply, ecological and agricultural impacts.

Over the March—August timespan, the 2022 rainfall total for the UK ranks 7th lowest in the Met Office series from 1836 and, for England & Wales, only 1995 and 1976 have been drier —— both marginally. Scotland was less impacted but still registered its 15th driest March-August on record with particularly notable rainfall deficiencies in many eastern river basins. In Northern Ireland, the drought was of a shorter duration and less intense; nonetheless rainfall in the July—August timeframe was the 6th lowest on record.

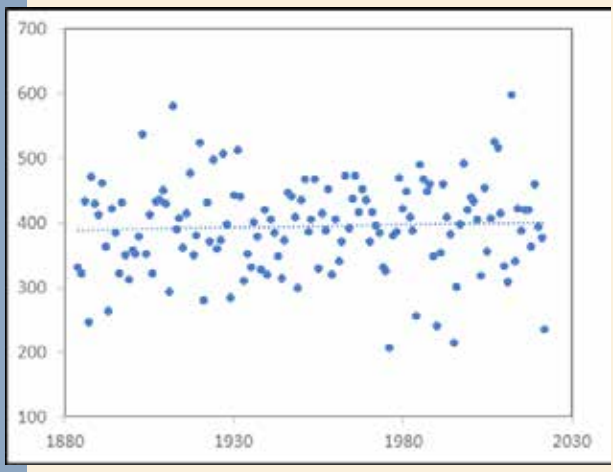


Fig. 1. March-August 2022 rainfall totals (mm) for England & Wales

For England & Wales, no significant long-term trend is evident in the March-August rainfall totals (Fig. 1) but temperatures have increased by an exceptional 1.4°C (in UKMO series from 1884) and 2022 is clearly the warmest on record. The singular nature

of this year's spring and summer drought is emphasised in Fig. 2 which confirms that 2022 is a clear outlier when temperature and rainfall anomalies are considered jointly. The very limited rainfall, exceptional evaporative demands and increasingly arid soil conditions impacted directly on river flows, aquifer recharge and reservoir stocks.

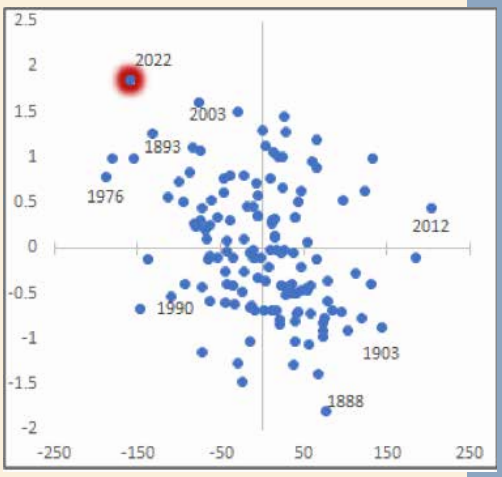


Fig. 2. England & Wales March-August rainfall (mm) and temperature (°C) departures from the long-term average

Following notably high rainfall and extensive flooding during February, river flows declined steeply across most of the UK and, with the exception of moderate spate conditions in mid-August, outflows from England & Wales remained below the daily long-term average until late September. Runoff from England & Wales over the April-September period was only marginally greater than recorded during the extreme drought of 1976 (Fig. 3). A number of index rivers, from the Tweed to the Exe recorded, their lowest April-Sept runoff on record and the Carron in north-west Scotland was the only index river to register above average runoff in this timeframe. Although a few groundwater-fed rivers, including the Coln (Cotswolds) and Waveney (Norfolk), registered new minimum September runoff totals, the early autumn witnessed some recovery in river flows across most of the country. The recoveries were then reinforced as the Jet Stream directed a sequence of vigorous Atlantic low-pressure systems across much of the UK during much of October and November (Fig. 4).

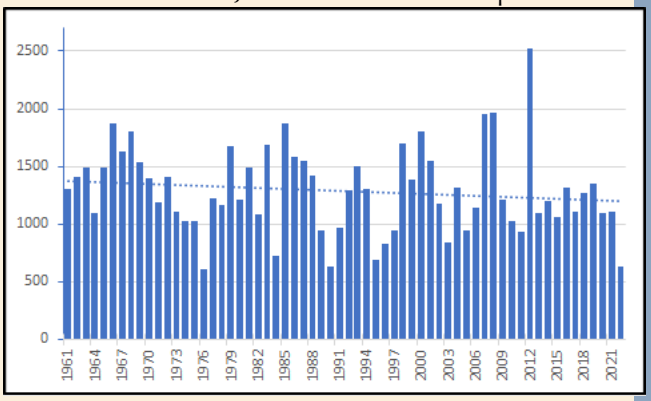


Fig. 3. April-September runoff totals for England and Wales (m^3s^{-1})

Aquifer recharge and groundwater resources across most of the UK primarily

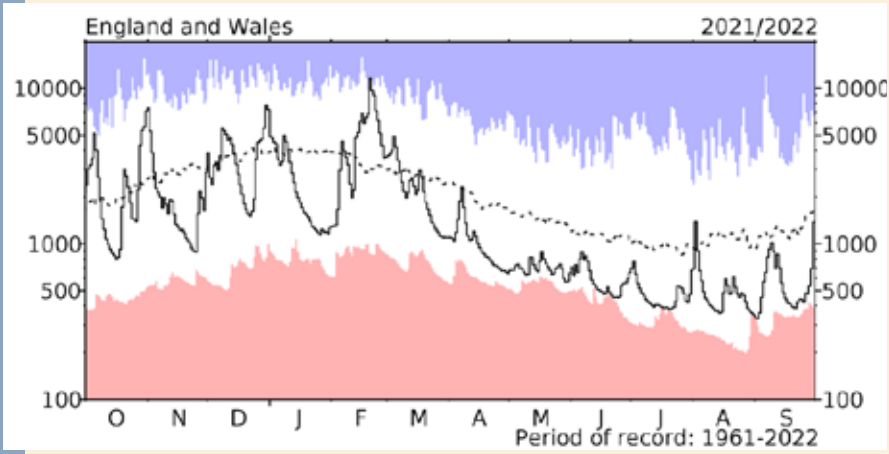


Fig. 4. Daily outflows from England & Wales (m^3s^{-1}). The blue and pink envelopes are the highest and lowest daily mean flow on record; the broken trace is the long-term daily mean.

reflect winter half-year precipitation totals. Over the latter half of 2021 groundwater levels generally tracked within the normal seasonal range and the wet February in 2022 usefully boosted groundwater resources. The arid March then generally served to terminate the recharge season —— correspondingly, groundwater levels declined and, with minimal recharge, continued to do so well into the late autumn in many areas. By late September, levels in some index wells and boreholes, including Chilgrove (Sussex) where monitoring began in 1836, were approaching their lowest on record. However, aquifer characteristics were clearly also influential. In the slow-responding Upper Greensand at Lime Kiln Way (Wiltshire) groundwater levels tracked close to the average for the time of year whilst levels in the Carboniferous Limestone in south Wales were below previous recorded minima by the late summer. Entering the spring, reservoir stocks —— a few southern impoundments excepted —— were close to capacity across most of the UK. Thereafter, the meagre rainfall and exceptionally high soil moisture deficits greatly restricted inflows. Correspondingly, reservoir stocks declined steeply and, by the end of August, more than half of the index reservoirs in England & Wales were at less than 50% of capacity. Brianne (Wales) and Colliford (South-West England) were among the major reservoirs recording their lowest stocks for the time of year*. This, together with parched soils conditions across most of the country, triggered the introduction of hosepipe bans and public appeals to restrain water demand.

(* in a series from 1988)

The autumn saw a clear diminution in drought intensity as cyclonic weather patterns became dominant. September and October rainfall was around 20% above average for the UK—— but with significant regional contrasts. Soil moisture deficits and the depth of the unsaturated zone meant that groundwater levels in many index wells continued to fall and flows in some groundwater-fed rivers —— like the Waveney —— remained depressed. Reservoir stocks generally began to recover but further declines were registered in a few index reservoirs, in the South-West particularly. The passage of a sequence of vigorous Atlantic low-pressure systems in November thence saw the primary focus of hydrological concern shift to flood risk.

Drought is a recurring feature of the UK climate and water resources and river management strategies have evolved to address the stresses caused. However, global warming is an increasingly exacerbating factor and the rising temperatures, coupled with arid soil conditions and meagre river flows will present real adaptive challenges to moderate the impacts on water supplies, agriculture and aquatic ecology.

Terry Marsh
16/11/20

This short report draws primarily on data & information from the Met Office, the CEH/BGS National Hydrological Monitoring Programme – the latter capitalising of data supplied by the Environment Agency; Scottish Environment Protection Agency; Natural Resources Wales; Northern Ireland Environment Agency and the UK water companies.

New members

Joanna Davies.....University of Exeter
Matt Floyd.....Santec, Witney
Vasileios Giannakopoulos.....Univerity of Lancaster
Padraig Gilhooley.....Mott MacDonald, Edinburgh
Xuehao Liu.....British Geological Society, Nottingham
Rebekah Morris.....Environment Agency, Huntingdon
Thea Wingfield.....Environment Agency, Liverpool



Some reflections on this major event *

Imogen Barnsley:"Covid-19 restrictions meant I'd had very little opportunity to attend the conference circuit throughout my time as a PhD candidate, despite "academic outreach" and "information dissemination" being very much part of the job description. Having now finished my PhD and aware that you're meant to ensure your research has 'impact' I submitted a presentation to the BHS National Symposium and secretly hoped it wouldn't be accepted. It was.

A month later I found myself at Lancaster University in their modern and brand new-smelling conference building rubbing shoulders with people I'd been citing for years but never thought I'd actually meet – Keith Bevan, Simon Dadson, Steve Birkinshaw, to name but a few. Alongside the academics was a healthy mixture of practitioners and government agencies – a good mix for a lively debate!

We were off with a bang with the keynote speaker, Katy Peat (Head of Adaptation Science for DEFRA) informing us that this years' prolonged drought and high temperatures was the first time climate scientists can confidently, and with no caveats, state that this weather is 'outside the normal range for the UK' and is due to climate change. A hush filled the room as I'm sure I'm not the only one who was gobsmacked. It was the lack of caveats that really shook me. The evidence has been clear for decades, but scientific certainty is not an easy point to reach.

What on earth could follow that!?

My main intention in attending the BHS conference this year was to participate in the multiple sessions centred on Natural Flood Management. On the first day we had some fantastic presentations that got in to the nitty gritty of modelling and assessing the impact of Natural Flood Management methods on flows. Liz Follett took us through the impact of spacing in a series of leaky barriers on their flood mitigation effects in a 1D model, demonstrating the importance of NFM placements (even if only in models). A super nifty portable flume contraption used by Stephanie Bond to measure hillslope roughness in the field ruffled some feathers by finding that moss generated greater roughness effects than woodland (at a small scale I might add – the data stood up to interrogation!). Further, Keith Beven demonstrated how the retention time of additional catchment storage must be synced to the time to peak of a flood to gain the maximum flood peak storage. All of which are very useful and important pieces of information for those of us who spend our days attempting to represent NFM in models before applying it in the real world. Some answers to some tricky problems which have vexed many a hydraulic modeller.

The second day felt more focused on the larger scale of NFM – the efficacy of NFM interventions over time, maintenance, and monitoring. Nick Chappell presented his

**I thought it was one of the best ever – Ed*

network on small flumes which have been installed across Cumbria which are used for detailed post-implementation monitoring downstream of NFM installations to assess the effect of flows. Chris Skinner and Tim Howson demonstrated how landscapes evolve over time and leaky dams and storage ponds implemented a decade ago evolve and become a part of the landscape (but by the same processes have reduced capacity and are less effective as flood mitigation measures). Angus Middleton blew our socks off by showing how they had managed to achieve an extensive catchment-scale NFM implementation programme on a £1 million budget! I also presented my PhD research about applying Natural Flood Management methods in groundwater-dominated catchments. Previous experience has told me that carefully outlining the unusual flood processes in chalk catchments help people understand the unique issues faced in chalk catchments. Thankfully, I was in a room full of hydrologists, and they understood the predicament.

If I were to sum up my take-home message from the whole conference it would be "monitoring data". Hydrometric data is the bedrock of our hydrological practice, and without good foundational data, we really can't make good estimates. There are some exciting steps forward: according to Nick Everard we can measure flows from space(!!) using satellites, and the Environment Agency are refining a new tool which will make data requests for hydrometric data a thing of the past (I hear every project manager sigh with relief). And from the angle of Natural Flood Management, how can we properly measure the effects without some solid pre- and post-implementation flow data? It's really good to see this gap in the evidence base slowly closing. "

Imogen Barnsley,
JBA

Rhiannon Bryan had this to say

"The 14th British Hydrological symposium took place on 12th – 14th September, an opportunity for hydrologists from across the country (and abroad) to come together, after several years of cancellations due to COVID-19. This years Symposium was attended by a mammoth contingency from JBA, around 13 of us, which presented a great opportunity to meet other JBA hydrologists face-to-face after years on teams! This year's conference had a very packed programme (with hardly enough time to eat your sandwich at lunch before heading into the next session), featuring presentations across a broad spectrum of topics. Reflecting on the first day, one of the key themes that came through for me was around data, how we use it, new sources of data and what data we need more of. Key talks of interest for me on this were Thomas Kjeldsen on the use of POT in estimating design floods in comparison to AMAX, and by Nick Everard on using drones and satellite data to estimate peak flows. I also attended the International Hydrology session, which was an interesting contrast to the work in the UK being presented. The talks in this session generally focused on practical hydrology, going back to basics in the face of limited or no local data. A particularly interesting aspect of the talks I found was the link between politics and the quality of the gauge records, with an excellent example presented by Tom Beskeen of Mott McDonald, who described how the quality of the gauge records changed in

his catchments in the Balkans through the breakdown of the Soviet Union through to the present day. Perhaps this link is obvious, but it is an interesting social aspect to hydrology that we don't see in our work in the UK.

The second day held more sessions which were more based around drought and ecohydrology, with a key session of the day being the Floods and Droughts Research Infrastructure (FDRI) panel. A NERC project, which has secured £38 million pounds worth of funding to facilitate research and innovation into making the UK more adaptable and resilient to floods and droughts. It is intended to be a be a community co-designed, UK-wide catchment-scale hydrological monitoring and digital research infrastructure. They are moving towards the planning phase of this project and have selected five test catchments, where they will set up monitoring networks allowing near-real-time analysis and open access data of catchment wide processes (not just flows). As to be expected there was a discussion within the session over the catchments chosen, which though intended to be UK wide are in my opinion are quite England centered. This represents a really good opportunity for the UK hydrological community across academia and industry and I have included a link below to the website, which is well worth a read, with the option of getting involved and giving feedback.

https://www.ceh.ac.uk/our-science/projects/floods-and-droughts-research-infrastructure-fdri

The third day was a field trip which started with a trip to a gauge station, with demonstrations of flow measurement using an ADCP and drone by Nick Everard. We then moved on to Thirlmere Resilience scheme, where representatives from UU talked through the catchment improvements they have been making there, and the challenges they have faced. This was a brilliant way to wrap up the conference, and a chance to get out into the Lake District was a welcome change from looking at catchments and gauges from my desk!"

Rhiannon Bryan
JBA Consulting

And from the 'chief organiser'
"I would like to thank Imogen Barnsley and Rhiannon Bryan, both early career presenters and BHS members, for their personal perspectives on the Fourteenth National Hydrology Symposium ('BHS2022'). We were able to attract 41 early career researchers, including 30 students to present at BHS2022, so I am pleased with their positive experience. This BHS community, combined with retired members, were perhaps the most impacted by restrictions on in-person networking opportunities over the 2020-21 period (President's Perspective Circulation 149). As an acknowledgement of this, the BHS2022 organising committee with the support of the BHS Main Committee chose to subsidise the registration fee for these members – facilitating 60 early career and retired folk to participate.

I am so grateful to BHS members for investing so much of their time to prepare what were highly professional and stimulating presentations for BHS2022. Over the two days, 100 oral presentations and over 50 posters were shared with the UK hydrological community prompting good discussions ably facilitated by the session chairs. Of equal value to the 214 delegates on the first day of the conference and 205 on the second day, were the informative

and engaging exhibits and computer demonstrations. The cutting-edge work and tools shown added considerably to the experience for the delegates, and we hugely appreciate the enormous efforts involved in preparing and hosting the stands.

Over 160 delegates were able to join the conference dinner, and over 70 the group meal on the second evening. In addition to the great conversations at the dinner table, I particularly enjoyed the opportunity to see Celia Kirby receive the BHS Lifetime Achievement Award from BHS President Hayley Fowler. The following day, some the BHS Presidents serving the Society with Celia were able to come together for a photo







(From left to right: Rod Hawnt 2005-07; Peter Ede 2017-19; Nigel Goody 2013-15; Hayley Fowler current BHS President; Celia Kirby retiring BHS Technical Secretary; Nick Chappell 2019-21; and Andrew Black 2009-11):

On the last day of the symposium, some 97 delegates had been able to join one of three informal coach trips to locations in the Lake District. Weather was kind us and I am very grateful to staff from United Utilities, UKCEH and the Environment Agency for delivering excellent field demonstrations and presentations – for example the river gauging demonstration at Bowston weir shown in the photo.

Local logistical considerations kept me rather more busy prior to and during BHS2022 than I would have hoped, though the upshot of this – has been the delivery of greater profits to BHS to support future activities for members. A huge thank you to all presenters, delegates and exhibitors for making Fourteenth National Hydrology Symposium such a rewarding event.

Nick Chappell
Chair of BHS2022 Organising Committee
2019-21 BHS President

What is hydrology?

I was at the BHS2022 symposium on Tuesday 13th September and there was a session called"How valuable is hydrology in flood warning systems?" I suggested to some of my peersthat this was an odd title because I'd considered hydrology to be the fundamental part of flood warning. 'Modelling water level or flow as a function of rainfall' sounds very hydrology to me.

Do we ask how valuable meteorology is to weather forecasts and associated weather warnings?

One eminent hydrologist suggested it wasn't necessarily hydrology because it can be done with an entirely empirical approach - with no process understanding.

The 'Flood Estimation Handbook' statistical method can be applied without any process understanding. There is the 'median' annual maximum flow (QMED), estimated with a 'regression' in ungauged catchments. Pooling groups are formed, and statistical distributions are applied to maximum values. Such an approach can be applied to anything from financial data to earthquakes. Rainfall depth duration frequency curves are entirely statistical and involve no modelling of any rainfall processes. Most rainfall simulators are also entirely statistical. Are these not hydrology either? Another eminent member of our community suggested that hydrometry was separate. Many sciences from the social sciences to the science of quantum mechanics would be a little sparse if they had to discount any statistical/empirical methods, or associated data gathering, as outside their science. Statistics and machine learning (which is essentially automated statistical modelling) are applied across all sciences. If a neuroscientist is working with machine learning methods to model the response of the brain to stimulus, are they not doing neuroscience?

Hydraulics and hydrology are often separated. In an article called 'The Art of Hydrology' published in HESS (2008), Professor Savenije suggests this separation is necessary as hydraulics is engineering and hydrology is science. Hydraulics is considered in a bottom-up, reductionist, way. Whereas hydrology is considered in a top-down, empirical, way. It's also suggested that hydrology is artistic in that imagination and innovation are required. I'd agree, all science is artistic in that sense. To be a scientist it's not enough knowing the current methods and paradigms. The aim of a scientist is advancement, and this is only possible with imagination and innovation. As Einstein supposedly said, "Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world".

For practical purposes the separation between hydraulics and hydrology is applied in the flood risk management industry. Broadly speaking the latter is flood frequency analysis using FEH type methods and conceptual rainfall runoff modelling. The former being any hydrodynamic modelling. Oddly, all this suggests that in some cases empirical methods are considered "not hydrology" (if no process understanding is applied) and in other cases physics-based methods are considered "not hydrology". Either way, hydrology is being redefined in a narrower sense.

However, there is also an implicit contradiction to such

restricted definitions. The session questioning the value of hydrology was about flood warning and it was held at a British 'Hydrological' Society event. There was also a session dedicated to hydrometry and many oral presentations about methods primarily involving empirical and/or hydrodynamic methods (all at a 'hydrological' society event).

There are many definitions of hydrology that can be found on the internet and in textbooks. See some definitions at the bottom of this article. They are all relatively broad, the broadest I found being the definition on our BHS webpage: "Hydrology is the study of water in the environment". In the '*Handbook of Hydrology*' (1993), Maidment dedicates two pages of the first chapter to defining hydrology, hydrology as a science, and hydrology as a profession.

Then an additional page describing what hydrologists do (see screen shot of the opening paragraphs shown below).

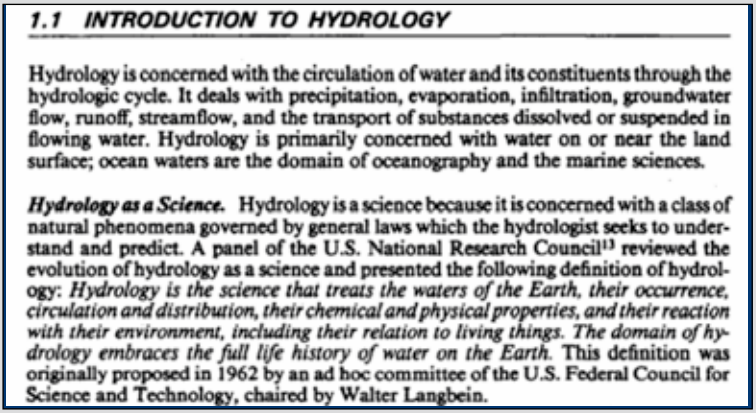
We appear to consider the broader definition generally, but often define hydrology narrowly as frequency analysis and/or 'the study and understanding of the movement of water through the catchment'.

Why do we do this? If there is a good reason for doing so, should we consider a new name for this latter sub-discipline of hydrology? 'Catchmentology' perhaps? Any catchmentologists out there?

When asked what I do, I use the term "flood hydrologist". I say I study and model extreme rainfall and river flows/levels (I also note coastal flooding too). To me this is a small part of hydrology which can be informed by any other part. It can involve any tools and any data/information necessary to facilitate the aim of achieving improved results and/or improved understanding.

Are there any other sciences which have such an identity crisis?

Anthony Hammond,
JBA



1.1 INTRODUCTION TO HYDROLOGY

Hydrology is concerned with the circulation of water and its constituents through the hydrologic cycle. It deals with precipitation, evaporation, infiltration, groundwater flow, runoff, streamflow, and the transport of substances dissolved or suspended in flowing water. Hydrology is primarily concerned with water on or near the land surface; ocean waters are the domain of oceanography and the marine sciences.

Hydrology as a Science. Hydrology is a science because it is concerned with a class of natural phenomena governed by general laws which the hydrologist seeks to understand and predict. A panel of the U.S. National Research Council[1] reviewed the evolution of hydrology as a science and presented the following definition of hydrology: *Hydrology is the science that treats the waters of the Earth, their occurrence, circulation and distribution, their chemical and physical properties, and their reaction with their environment, including their relation to living things. The domain of hydrology embraces the full life history of water on the Earth.* This definition was originally proposed in 1962 by an ad hoc committee of the U.S. Federal Council for Science and Technology, chaired by Walter Langbein.

USGS: "Hydrology is the science that encompasses the occurrence, distribution, movement and properties of the waters of the earth and their relationship with the environment within each phase of the hydrologic cycle"

National Geographic: "Hydrology is the study of the distribution and movement of water both on and below the Earth's surface, as well as the impact of human activity on water availability and conditions"

Wikipedia: "Hydrology is the scientific study of the movement, distribution, and management of water on Earth and other planets, including the water cycle, water resources, and environmental watershed sustainability"

Google: "The branch of science concerned with the properties of the earth's water, and especially its movement in relation to land"

Shaw *et al* (*Hydrology in Practice*** – 2011): "a multi-disciplinary subject, dealing with the occurrence, circulation and distribution of the waters of the Earth"

Ward & Robinson (*Principles of Hydrology* – 2000): "Hydrology is the science dealing with the waters of the earth, their occurrence, distribution, and circulation, their chemical and physical properties and their interaction with the environment. This book focuses on the principles of hydrology which are concerned largely with physical hydrology, which is sometimes known as environmental hydrology. In this context, water is viewed in the same way as soil, vegetation, climate or rock, as an element of the landscape to be investigated and ultimately understood by means of

"Stand-up for Hydrology!"

Calling Early Career Hydrologists

The BHS main committee would encourage you to stand-up for hydrology and invite you to monthly on-line Early Career Talks, arranged by Early Careers for Early Careers from January 2023.

These talks are aimed at sharing experiences and ideas of early career hydrologists from both academia and industry in a relaxed and informal environment – opportunity for receiving peer-to-peer feedback, practising your presenting skills and building up your hydrology network. These one-hour sessions can have 2–3 talks, lasting around 10–15 minutes each with time for questions and feedback.

If interested, please, get in touch via email with

giuseppe.degandidieco@bristol.ac.uk.

We look forward to hearing your hydrology thoughts.

The **National River Flow Archive (NRFA)** has released an update to its Peak Flow Dataset including the files for use in the WINFAP software for flood estimation.



The dataset includes Annual Maxima (AMAX) and Peaks over Threshold (POT) data for 939 gauging stations which have been updated with an additional water year of data (October 2020 to September 2021) in England, Scotland, Wales and Northern Ireland. New AMAX1 records were established at 29 stations during water year 2020/2021 in northern England, eastern England and Wales!

As well as the additional water year of data, a Period of Record Review was undertaken at 100 stations across England, Scotland and Northern Ireland – around 4,600 years of data! In Wales, tasks were undertaken to review metadata, gaugings and ratings at 31 stations, plus an assessment of duplicate POTs for all sites in Wales.

The NRFA's Peak Flow Dataset provides flood data for 939 river flow gauging stations around the UK. The data can be used with the flood estimation methods set out in the Flood Estimation Handbook (FEH), which is the industry standard for current flood estimation in the UK. The Peak Flow Dataset has been shown to provide net economic benefits of almost £5.4 million per year in terms of costs saved by environmental consultants and regulators.

The peak flow data provided through this service originate from gauging stations operated by a range of UK hydrometric measuring authorities as is the case with other NRFA data. Maintenance of the NRFA Peak Flow Dataset, including the latest update, is carried out under a collaborative project between the UK Centre for Ecology & Hydrology, the Environment Agency, Natural Resources Wales, Northern Ireland's Department for Infrastructure – Rivers, and the Scottish Environment Protection Agency.

The updated NRFA Peak Flow Dataset was released on 7th September 2022 and reflects the NRFA data holdings at this time. Version 11 of the NRFA Peak Flow Dataset is the eighth version released since the NRFA took over the stewardship of the national peak flows database. Updated peak flow time series and metadata are now available to view on the NRFA website and can be found using the NRFA's gauging station search tool. Download the NRFA Peak Flow Dataset V11: https://nrfa.ceh.ac.uk/peak-flow-dataset

Alannah Killeen
NRFA

Flood estimation impacts of updating from NRFA v10 to v11

Statistical methods for fluvial flood frequency estimation use the National River Flow Archive (NRFA) Peak Flow Dataset. This includes annual maxima data for gauging stations across England, Wales, Scotland and Northern Ireland, which is updated on an annual basis. The latest update, version 11, was issued on 7th September 2022 and includes an additional water year of data for 939 gauging stations, the addition of 6 new gauging stations, and a period of record review for 131 gauging stations. Full details of the update can be found at https://nrfa.ceh.ac.uk/news-and-media/news/nrfa-peak-flow-dataset-version-11-released.

To understand the potential impacts of the update on pooled statistical assessments, we have undertaken a comparison using a sample dataset of 6012 catchments purchased by the Environment Agency through the FEH Webservice from 2016 to 2021. This dataset is considered representative of the distributions of catchment properties typically used in flood modelling projects in England.

A pooled statistical analysis was undertaken for all of these catchments using the "QuickResults" function of the UKFE R-package developed by Anthony Hammond. All catchments were assumed to be ungauged, QMED was estimated from catchment descriptors and adjusted using two donors automatically selected, and a stationary methodology was applied with the generalised logistic distribution fitted.

Findings

The results showed that:

- For QMED, NRFA v11 gives very similar results compared to NRFA v10 for almost all catchments.
- For the 1% (1 in 100) AEP event, most (94%) flow estimates remain within ±5% of the v10 estimate (Figure 1). These are skewed towards a decrease in flow estimates (71% of estimates are smaller in v11).

Investigations revealed that the decrease in flow estimates was associated with smaller catchments, and in particular the addition of a new gauging station to the NRFA v11 database. Station 26017 (Ings Beck at South Newbald) was added to the dataset in NRFA v11 and is present in 44% of the pooling groups derived using v11. This has a small catchment area (14 km^2) and a relatively flat flood frequency curve which could

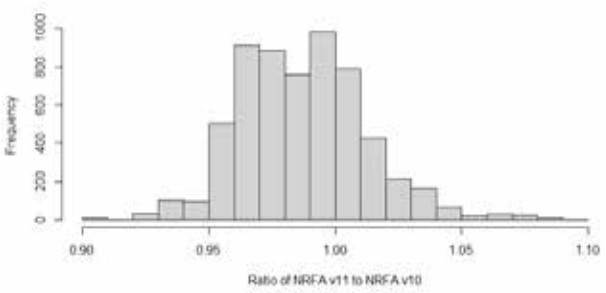


Fig. 1: Histogram of ratios of NRFA v11 to NRFA v10 peak flow for the 1% (1 in 100) AEP event, based on a sample of 6012 catchments.

cause a reduction in flow estimates in the pooling groups that it is added to. Station 26017 is also highly permeable (BFIHOST19 of 0.94). Although pooling groups are not selected using soil catchment descriptors, some analysts may review pooling groups and remove sites that do not have a similar geology.

"After further checks, we are recommending that Station 26017 is considered OK for QMED only and is removed from all pooling groups that it appears in."

The analysis was also re-run using the small catchments pooling method, which selects stations based on area and SAAR catchment descriptors alone, with less weighting towards area. The method was run using a subset of 4003 catchments with an area less than 40 km2. The results showed a similar impact, with a decrease in flow estimates for v11. Station 26017 appeared in 85% of the v11 pooling groups using the small catchments method.

Comparing the small catchments pooling group method against the original pooling group method using NRFA v11, the small catchments method tends to give higher flow estimates. The choice of method can lead to significant changes in the flow estimates, in some cases with an increase of up to 50% in the 1% (1 in 100) AEP peak flow (Figure 2).

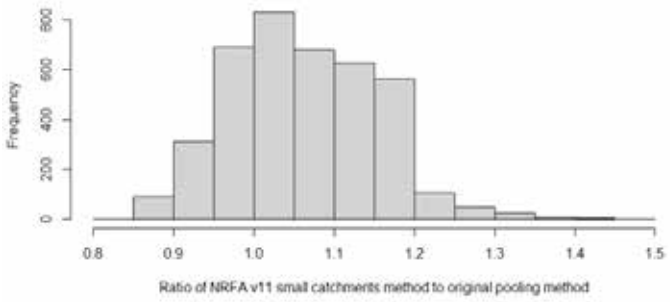


Fig. 2: Histogram of ratios of small catchments method compared to the original pooling method for the 1% (1 in 100) AEP event, using NRFA v11 and a sample dataset of 4003 small catchments.

Conclusions and recommendations

For initial pooling groups, the transition to NRFA v11 will most often lead to slightly smaller flood flow estimates, particularly in smaller catchments. In about 30% of catchments, flow estimates will increase. No changes greater than ±10% are expected, based on the sample sites analysed.

The changes in small catchment estimates are thought to be in part due to the inclusion of a new gauging station, 26017, in the NRFA v11 dataset. This analysis has shown the significant impact that the inclusion, removal, or revision of a single influential gauging station could have on flow estimates nationwide. The choice of original or small catchments pooling group method can also significantly affect results. It is therefore important that analysts carefully consider pooling group method choices and pooling group composition when applying the statistical method.

We welcome feedback on this analysis. A longer report is also available. Please contact the National Flood Hydrology team via FloodHydrology@environment-agency.gov.uk

Clare Waller
Environment Agency

LETTERS

Dear Editor

We read with interest the article by John Rodda *et al.* in *Circulation N. 154*. Anniversaries are a time to look back with hindsight especially in the light of new knowledge that has been gained since. Although the event was extensively reported in the days and months following the event, we would suggest the following papers could provide some additional ideas (Harris, 1992[1], Clark, 2001[2], 2004[3], 2017[4], and a book by Prosser 2001[5]).

It is vital that we learn as much as possible from any major flood. This includes:

1. An estimate of the rainfall and its rarity.
2. An estimate of the peak discharge using more reliable modelling methods than ReFH2.
3. An estimate of the peak discharge using critical stream power and field evidence from boulder dumps.
4. Placing the 1952 event into a flood frequency for the West Lyn.
5. Whether a flood warning be given if a similar storm took place in a catchment of about 20km2?

We should guard against forsaking or neglecting previous information and deductions simply because they have seemingly become outmoded in present-day practice. This especially applies to eye witness reports and local information. For instance, one of the authors this letter, C Clark, has investigated a number of small, flood-prone catchments retrospectively to better understand soil and soil water characteristics. Careful post-event studies are essential and these may need a multi-disciplinary approach. The bottom line is that these major events have happened and will continue to happen, and will not always fit a general model. The widespread existence of 'un-official' raingauges should be recognised and used with care, as they can provide very useful information on localised rainfall conditions (Dent *et al.,* 2021)[6]. Flood hydrology is still very reliant on field and observational experience, which unfortunately has declined in recent years, with increasing dependence on modelling.

With a wide variety of membership we have to ask ourselves two questions: who benefits from our research, and when a difference in results is identified are we willing to discuss those differences?

Both the ReFH2 and the FEH13 rainfall web-service do not show how the results are calculated. Application of the former to the 1952 Lynmouth data has shown, yet again, that the method is giving results that are in all probability badly erroneous. The consequences of a similar storm should it occur over an urban area would be very serious. If sufficiently definitive information on rainfall depth, duration and area can be obtained, Storm Transposition over critical catchments

and urban areas could be attempted. This is an accepted method of good practice in many other countries, but the depletion of rain gauge networks over the past two decades does not always permit this method to be used.

Lynmouth had experienced an even more extreme flood event in 1770, and Boscastle has experienced other floods close to the magnitude of that in 2004. South-west England seems to be particularly prone to extreme rainfall events, e.g Martinstown (1955) and Cannington (1929), and yet we still seem overawed by these events. There is a need for better models which use data gathered in the field and not rely on equations to produce variables which are used in further equations. We thus regretfully conclude that not enough lessons have been learnt and put into practice since the Lynmouth flood of 1952.

Yours sincerely

Colin Clark, James Dent

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5 Prosser, T. 2001 *The Lynmouth Flood Disaster*. Lyndale Photographics Ltd. 99pp. Lynmouth.
6 Dent, J., Clark, C., Holley, D. 2022 Thunderstorm and extreme rainfall in south Norfolk, 16 August 2020: hydrological response and implications. *Weather*, **77**, 296–302.

Dear Editor,

Hydrological Science Going Backwards?

I refer to Circulation No. 154 – "Lynmouth 70 years on."
The article tells us that "Normally for a flood study the design flood for a given return period (e.g. 1 in 100 year) is estimated …."
I haven't done a flood estimate for a few years now, but I thought we had moved away from the 1 in so many years concept to the more helpful risk level description e.g. a 1% chance of occurrence. Did I miss something, or is hydrological science going backwards?

John Mosedale

Update on the EA's Flood Hydrology Improvements Programme

It has been just over a year since the Environment Agency's Flood Hydrology Improvements Programme (FHIP) reported to readers of *Circulation*. Since then, the team has started to deliver the programme, welcomed new members, engaged with the hydrological community on our programme and supported the Flood Hydrology Roadmap Board. We wanted to take this opportunity to provide you all with an update on our progress and highlight how you can continue to be involved.

The Flood Hydrology Improvements Programme is the Environment Agency's contribution to the delivery of the UK Flood Hydrology Roadmap (FHR). It is a 6-year, *c*. £7M programme with 19 projects covering three of the four FHR themes of Ways of Working, Data and Methods. The programme is centred on delivering benefits for England, but we anticipate working with colleagues from the Scottish Environment Protection Agency, Natural Resources Wales and Department for Infrastructure Northern Ireland, where possible, to offer benefits across the UK.

Since August 2021, we have welcomed several new members to the team. Selena Peters joined the team as Project Executive, where she will be using her expertise to manage the team and ensure smooth delivery of the programme. Selena will be working alongside Lead Hydrologist Anita Asadullah (with Helen Harfoot covering until April 2023), who will be continuing to provide technical leadership to the team. Senior Hydrologists Sara Alexander and Martin Borthwick joined Chris Skinner, Helen Harfoot (from April 2023), Jo Cullen (until January 2023) and Esther Goodship (until March 2023). Our programme and project management was bolstered with the arrival of Programme Manager Caroline Brannon, Senior Project Manager Andy King and Project Manager Laurence Ralph. Annie Ockelford has joined the team as Engagement and Comms Lead.

In November 2022, we celebrated the completion of our first project on the relative importance of the hydrological uncertainties within the flood modelling chain. This project explores which sources of uncertainty are most important within the end-to-end analysis (or "modelling chain") for several applications that include flood hydrology. The project includes a literature review, six case studies and five main recommendations for improvements to reduce uncertainty in flood hydrology, ultimately helping to make flood risk management more robust. The report for this project will be available for all to download via our new FHIP engagement website in the new year or directly from the FHIP team in the interim.

The FHIP team is currently busy delivering the following projects:

- Quantifying and communicating uncertainty in the hydrometric data that supports flood hydrology (this project aims to implement new uncertainty metrics in EA

hydrometric data sets through identifying user needs, priority datasets, gaps, and national/international best practice). Phase 1 is due to complete Summer 2023

- Open methods in operational flood hydrology (this project aims to consider the feasibility and practicalities of applying internationally recognised principles of open science to the models and methods used in operational flood hydrology and provide recommendations for the Environment Agency). Due to complete Summer 2023
- Hydrological priorities and network appraisal (this project aims to analyse the spatial distribution of flood risk across England to identify 'hydrological priorities' and appraise our associated monitoring networks to identify current and future gaps in the networks and make recommendations for improvements). Due to complete Summer 2023
- UK Skills Survey (this project aims to develop a UK wide skills survey to baseline the current diversity, skills and satisfaction of hydrologists practising in UK and undertake detailed interviews with industry and academia to identify any skills gaps.) For further information please refer to our article on this elsewhere in this issue. Due to complete Spring 2023 – please complete and spread the word!
- Ways of Working in the Environment Agency (this project aims to review current way of working in hydrology from project conceptualisation and scoping through to commissioning and quality assurance and make recommendations for ways to improve efficiency or quality) Due to complete Spring 2023
- Increasing access to data (this project aims to extend the existing Hydrology Data Explorer to include sub-daily river flow, river level, groundwater and rainfall data for open Environment Agency stations to enable open access to flood hydrology data). Due to complete early Spring 2023.

Scopes for many of these projects were reviewed by FHIP community representatives from across the academic and practitioner community. These reviews resulted in valuable feedback, and we anticipate stronger projects as a result. A huge thank you to all those who volunteered as FHIP community reps.

We are keen to make FHIP accessible to anyone who is interested. This will be aided with the launch of our FHIP engagement website, which we anticipate coming online early 2023. It will provide details of each FHIP project alongside timescales, contact details and offer the opportunity to ask questions or provide feedback. We hope that this will enable more of the hydrological community to get involved in FHIP and keep pace with our programme. In the meantime, if you have any questions or queries for the FHIP team please contact us at: fhip@environment-agency.gov.uk

Helen Harfoot,
Flood Hydrology Improvements

UK Hydrology Skills & Satisfaction Survey
We need your help!

The first UK hydrology skills and satisfaction survey will be going live in early 2023 and we need your help to make sure it is as useful as possible.

The survey aims to get a snapshot of those who practise hydrology (not just those who call themselves hydrologists), including data on who they are, what jobs they do, what skills they have and use, and what skills they would like to gain. The data, as far as it can be anonymised, will be made publicly available for the community to use, for example for evidencing the need for new training provision. We are flagging the survey early here as we need your help, both in filling out the survey when it goes live in early 2023 and by sharing it widely to reach as many people as possible who use hydrology or have hydrology skills.

he survey is being facilitated by the Flood Hydrology Improvements Programme (FHIP) at the Environment Agency, in conjunction with the Flood Hydrology Roadmap Board. This is being done on behalf of the hydrology community in response to Action W5 of the 25-year Flood Hydrology Roadmap*. The plan is for the survey to be repeated periodically throughout the Flood Hydrology Roadmap's 25-year span. Despite emerging from the Flood Hydrology Roadmap, the survey itself will cover all hydrology, not just high flows.

The survey aims to capture data across four key themes:

*Flood Hydrology Roadmap - https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/flood-hydrology-roadma



Background: who practises hydrology in the UK, their numbers and their characteristics.

Satisfaction: how happy they are in their roles and their prospects for future development.

Skills: What do they do and what are they trained to do.

Community activities: How embedded are they in the community and how do they contribute.

The greatest challenge in the success of the survey, both this first iteration and those that follow, is reaching the right people and persuading them to complete it. We need

to acknowledge that the BHS community does not include everyone in the UK who uses hydrology and hydrology skills in their work. For the Flood Hydrology Roadmap to be successful, we need to identify these groups and understand what they do and how they do it. We need to acknowledge that what we might call the hydrology community today will not capture all the hydrology happening and there could be hundreds, if not thousands, of people practising hydrology outside of our community.

As a community, we need this UK-wide hydrology skills and satisfaction survey to reach them too. We have defined four groups:

- Those who identify as hydrologists.
- Those who identify as using hydrology skills in their jobs.
- Those who had not previously acknowledged they use hydrology skills in their jobs.
- Those trained in hydrology skills and are not yet or no longer in a job that requires hydrology skills.

To achieve this, we need your help. Firstly, please do complete the survey when it is released in January 2023. It will be live for three weeks and the more returns we get the better the picture of UK hydrology will be. Those completing it will get to have



their say so do not miss out on your opportunity to do so Second, please share this as widely as possible with anyone you know who uses hydrology – even if they do not realise it. Please post the link on Twitter, Mastodon, LinkedIn, Facebook, Instagram, Reddit, Discord, TikTok, Yammer, mailing lists, carrier pigeon, and semaphore. Your help, as ambassadors for hydrology, will make a difference in reaching those we need to reach and bring into our community.

When live the survey link will be circulated via the BHS mailing lists and social media – do keep alert to this and share widely. If you would like help in sharing these to your own networks, please do contact us and we will send templates and ideas closer to the date: fhip@environment-agency.gov.uk fao W4 Skills Survey.

Chris Skinner,
Flood Hydrology Improvements Programme,
Environment Agency

UK Hydrological Bulletin: August – October 2022

UK temperatures over the period under review were remarkably high and rainfall for the three months was very close to the long-term average. However, its temporal distribution was atypical, resulting in an initial intensification of the already exceptional drought conditions. By the end of an extremely arid August, river flows and reservoir stocks were very depressed, particularly in England &Wales. This, together with parched soils and depressed groundwater levels, prompted the introduction of hosepipe bans and an increasing concern regarding the drought's impact on water resources, agriculture and aquatic ecology. The subsequent cyclonic weather patterns and sustained rainfall substantially moderated the drought's intensity and some flooding was experienced — particularly in urban areas. Weather patterns in 2022 thus far have served to underline the UK's vulnerability to climate change.

August was the third warmest on record for England &Wales – and the driest for the UK since 2003 – with rainfall only modestly above half of the long-term average. Rainfall deficiencies were greatest in parts of Wales and eastern and southern England; some areas recorded only 30-40% of the long-term average. In Sussex, Odiham reported a 42-day sequence of zero rainfall. By contrast, a few localities in western Scotland were notably wet; Achnagart recorded a 246 mm rainfall total in the first week. Elsewhere, sustained river flow recessions continued and the Gt Stour (Kent), Yscir (South Wales), Waveney (East Anglia) and Annacloy (Northern Ireland) were among rivers recording their lowest August runoff on record. In eastern Scotland, flows in the river Bervie served to exemplify the duration and severity of the 2022 spring/summer recessions (Fig 1). Across much of the UK the depressed river flows, combined with high water temperatures and low oxygen levels, posed an increasing threat to the aquatic environment

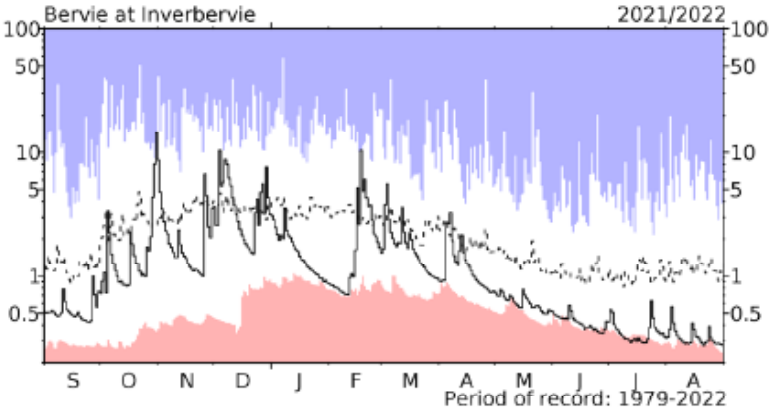


Fig. 1 Daily mean flows in the river Bervie. The blue and pink envelopes are the highest and lowest daily flows on record; the broken trace is the long-term average.

—- fish-rescues were required, e.g. in the Tamar (Devon), and Windermere was infected by extensive cynobacteria blooms. Several large reservoirs including Brianne (Wales) and Wimbleball (Devon) reported their lowest end-of-August stocks on record (in series from 1981) and levels in many groundwater wells and boreholes were depressed – Ashton Farm in the southern Chalk registered its 2nd lowest late-August level in a 49-year record. The very arid soil conditions across much of the country heightened concerns about the water resources outlook; accordingly, appeals were made to moderate water usage and an increasing number of hosepipe bans were introduced throughout the month.

At the national scale, September rainfall was modestly above average but regional and local variations were substantial. A few localities in eastern Scotland (e.g. in the Cairngorms) registered more than twice the monthly average, and Northern Ireland recorded its third highest September total since 1985. In contrast, parts of East Anglia recorded less than half the monthly average. During the first fortnight a cyclonic episode produced two-day rainfall totals of around 100 mm in parts of the Scottish uplands and Dartmoor. Correspondingly, notable spates were recorded on, for example, the Scottish Dee, Exe and Mourne (Northern Ireland). By contrast, rainfall deficiencies increased in substantial parts of East Anglia and South Wales. The impact on river flows was thus spatially very variable: runoff for the Scottish Dee being well above the monthly average whilst, in England, the Coln (Gloucestershire) and Waveney (Norfolk) registered their lowest September runoff on record. Generally, groundwater levels continued their seasonal decline – in the Carboniferous Limestone of Pant Y Lladron (South Wales) levels fell below previous recorded minima – in a 27-year series. Reservoir storage also continued to decline and month-end stocks in most major reservoirs were 30-50% below average for the time of year.

October was, provisionally, the 5th warmest on record for England & Wales with correspondingly high evaporative demands for the autumn. It was also wet, around 25% above average for the

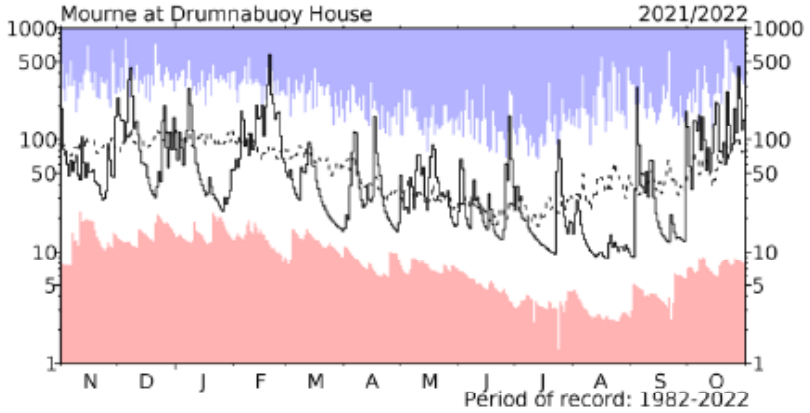


Fig. 2 Daily mean flows in the river Mourne. The blue and pink envelopes are the long term daily max and min flows on record; the broken trace is the long-term daily average

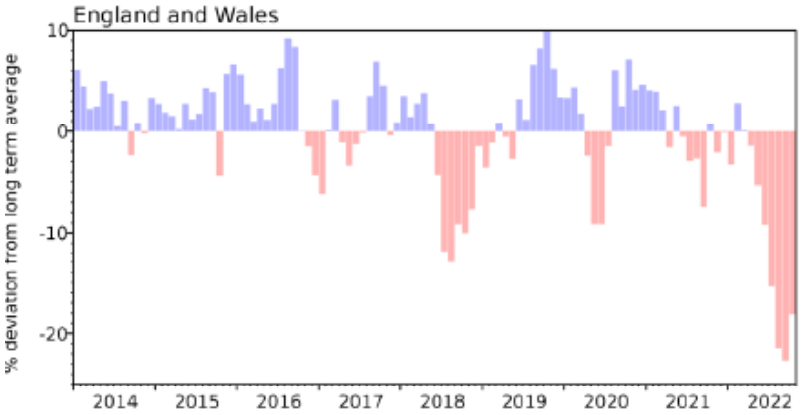


Fig. 3 A guide to overall month-end reservoir stocks for England & Wales.

UK but some, mostly eastern areas, were relatively dry. Early in the month, a series of Atlantic frontal systems, mostly from the south-west approaches, brought pulses of very heavy rain across the country. Over the 4/5th, 24hr rainfall totals of around 70 mm were recorded at Achnagart (northern Scotland) and Capel Curig; Dartmoor was very wet also. Correspondingly, high spates were triggered on, for example the Tyne, Tay and Lune. In Wales, flows in the river Wye reached the average for the time of year for the first time since mid-March. More notably, in Northern Ireland - which recorded its 2nd highest September/October rainfall since 1870 – the river Mourne recorded twice the average October runoff and a sequence of increasingly high spates (Fig. 2) served to underline a rapidly growing flood risk. However, spatial variations in storm totals, together with seasonally high soil moisture deficits, limited recoveries in many other river basins. In the Chilterns, flows in the groundwater-fed Chess remained considerably below the average for the time of year; this was also true of a number of other river and streams with baseflow-dominant regimes. A very mild but wet end to the month triggered many flood alerts with significant surface flooding, aggravated locally by heavy autumn leaf-fall and the consequent drain blockages.

Reservoir stocks declined further through the month in a few index reservoirs, including Bewl and Wimbleball in southern England but, but overall storage for England & Wales increased (Fig. 3) – with a further recovery in early November.

Terry Marsh
16/11/2022

TThe Hydrological Bulletins draw primarily on data & information from the Met Office, the CEH/BGS National Hydrological Monitoring Programme, the latter capitalising on data supplied by the Environment Agency; Scottish Environment Protection Agency; Natural Resources Wales; Northern Ireland Environment Agency and the UK water companies.



BHS2022 delegates negotiating upland territory on the Symposium's field trip