

# Circulation

No.145
May 2020

The Newsletter of the British Hydrological Society

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## Something good to look forward to...!

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# President's Perspective

*Time is a sort of river of passing events, and strong is its current; no sooner is a thing brought to sight than it is swept by and another takes its place, and this too will be swept away*

*(translated from Meditations, book IV-43 by Marcus Aurelius)*

**Essential workers**

Water company staff are working hard to ensure we have clean tap water and effective sewerage systems in this time of national crisis, when hand-washing and hygiene are so important. They are true stoical heroes, achieving this despite considerable pressures on them as individuals and on the sector (iwa-network.org/learn/a-utility-leaders-response-to-covid-19/). Those members not familiar with water company activities might be interested to watch this mini-video on raw water treatment by Wessex Water (www.youtube.com/watch?v=SdN3g85zfzM). Let's also appreciate those keeping our environment monitoring operational, constructing engineering schemes or increasing the capability of our computer modelling.

For university staff and students, the immediate challenge has been how to engage with research, teaching and learning activities when limited to our home computer screens. The expected longer-term financial shocks to academia, the business sector and our environmental charities are likely to be more difficult to accommodate.

**Supporting the BHS community**

Thanks to your support, BHS has been able to re-introduce the concessionary membership fee for our highly experienced and valued retired members (www.hydrology.org.uk/join_bhs_rev.php). The electronic ballot to change our Statutes to allow this, and other small changes, had overwhelming (96%) support from the membership that voted.

The current crisis underlines the need to train up the next generation of engineers, scientists and economists for a career in the water sector. Later this month we will advertise our competitive MSc scholarship programme, thanks to joint funding by BHS, the JBA Trust and the Environment Agency. Please promote this opportunity to your students or mentees. The BHS website now has direct links to the diverse range of MSc training programmes available across the UK (www.hydrology.org.uk/education_training.php).

**Networking opportunities**

Social distancing has temporarily stopped all BHS meetings in-person. I therefore feel fortunate to have been able to join an evening meeting of the vibrant BHS South East Section shortly before distancing was introduced (see meeting summary by Joe Pearce later in this issue).

The Fourteenth BHS National Symposium has been postponed from the summer to 7–9 Sep 2021, but there are lots of opportunities in the meantime to connect with other hydrologists online. The BHS Main Committee is investigating the possibility of a free online conference this summer to provide some networking opportunities for members. Before then, the

European Geophysical Union General Assembly (EGU2020) will be delivered free online from 5–8 May 2020 (meetingorganizer.copernicus.org/EGU2020/meetingprogramme), allowing members to connect with BHS colleagues and international researchers. There are free webinars organised by our Institution of Civil Engineers partner – the one on 7 May will cover 'Totnes Flood Defence Improvements' (www.ice.org.uk/events/totnes-flood-defence-improvements-webinar) and ICE's 2020 Gerald Lacey Lecture on 18 May will address 'Flooding in England - Past, Present and Future' (www.ice.org.uk/events/gerald-lacey-lecture-2020-england-flooding-online).

**Opportunities for online learning**

The severe restrictions on many of our professional activities gives us the opportunity to learn from the varied resources available online. All articles published in our journal *Hydrology Research* are now freely accessible online (iwaponline.com/hr/issue/1/1), with articles going back to 1 Feb 1970 when the journal was known as Nordic Hydrology. There is a plethora of videos of potential interest to hydrologists on the internet. My recent favourites include a presentation on novel stream gauging methods by USGS (www.usgs.gov/media/videos/reach-scale-monitoring-advances-stream-gaging), and an informative talk by Dr Julian Klaus on novel monitoring for hydrological modelling (www.youtube.com/watch?v=1yiVTFRDm_w), part of a successful virtual conference organised by the University of Birmingham for World Water Day 2020. Another favourite asks how tall trees lift water to their crown (www.youtube.com/tch?v=BickMFHAZR0&feature=emb_logo) – fascinating if a bit tangential to our discipline. More practically, our research student members may find Prof Jeff McDonnell's presentation on 'How to write a journal paper' instructive (water.usask.ca/hillslope/teaching/forest-hydrology-course.php#VideoLecture17).

**Looking forward**

While many of us have been fully occupied with immediate professional and family matters, our partner UKCEH has been looking ahead. On 22 Apr 2020, they published their five-year strategy for research and innovation to target major global challenges (www.ceh.ac.uk/news-and-media/news/ukceh-targets-major-global-challenges-new-strategy). One such challenge is ensuring good Water Quality and Resources for all, with those people most at risk from poor water quality living in unplanned settlements ('slums') in developing countries. Last month, the United Nations Human Settlements Programme stressed that covid-19 is likely to hit these vulnerable communities the most (unhabitat.org/un-habitat-covid-19-response-plan). Targeting WASH (Water, Sanitation & Hygiene) in slums has to be a new priority for hydrologists and related researchers (www.worldbank.org/en/topic/water/brief/wash-water-sanitation-hygiene-and-covid-19).

While thinking of the future, please do keep yourselves, family and colleagues safe.

*Nick Chappell*
*President BHS*

## Professor Michael Hamlin, 1930 – 2020



Mike Hamlin, President of BHS 1995 to 1997, died recently aged 90. Born in South Africa, he went to Bristol University and, after a spell of consultancy and a lectureship at Witwatersrand, he came back to a lectureship at Birmingham University and then Professor of Water Engineering in 1971. This was followed by appointments as Vice-Principal and Pro Vice-Chancellor, subsequently becoming Principal and Vice-Chancellor of Dundee University.

Mike was always a great supporter of BHS, including arranging for some of our meetings in the department on an informal basis (sadly no longer possible). It was during Mike's Presidency that the infamous whiskey tasting organised by Paul Younger took place at the 5th BHS National Hydrology Symposium held at Heriot Watt.

*Celia Kirby*

## New members

Gang Zhao.....University of Bristol
Rebecca Ing.....JBA Consulting, Birmingham
Richard Body.....HR Wallingford, Abingdon
Lorena Ramirez-Romero.....Landell Mills Ltd, Trowbridge
Elaine Hallliday..... Reading
Ken Mirunga.....Nairobi
Nikki Beale.....Environment Agency
Eoin Cullinane.....Nicholas O'Dwyer Ltd., Dublin
Alexnder Osbourne.....University of Durham
Ioannis Michalopoulos.....Newcastle upon Tyne
Ruth Goodall .....Aecom, Buxton
Jamie Hizzett.....Environment Agency, Southampton
A Collins.....Rothamsted Research, Okehampton
Camilla Negri.....James Hutton Institute, Aberdeen
Thomas Singleton.....JBA Consulting,

# Recent PhD theses

| *Author* | *Title* | *University* |
|---|---|---|
| Smith, Victoria | Analysis of the current state of water resource management in the UK using Social Network Analysis and Agent-Based Modelling: a case study in the Wear Catchment, County Durham uk.bl.ethos.783427 | Durham |
| Dobson, Barney | Uncertainty in modelling and optimising operations of reservoir systems uk.bl.ethos. 774507 | Bristol |
| Emerton, Rebecca | Extending the predictability of flood hazard at the global scale uk.bl.ethos.781126 | Reading |
| Fidal, James | Investigating the impact of urbanisation on rainfall-runoff models. uk.bl.ethods.782210 | Bath |
| Gafney, Gabriel | Environmental change and high status water-bodies uk.bl.ethods. 793760 | Ulster |
| Cooper, Elizabeth S. | Improving flood prediction using data assimilation uk.bl.ethods. 786474 | Reading |
| Vinogradova, Maria | Flood and extreme weather fatalities in the UK uk.bl.ethods. 789395 | King's College London |
| Webber, J. | Reliable and resilient surface water management through rapid scenario screening uk.bl.ethods. 775717 | Exeter |
| Kigobe, Max | Modelling the effects of land use change and climate variability on the hydrology of the upper Nile uk.bl.ethods. 555946 | Imperial College |
| Cumiskey, Lydia | Joining the dots: a framework for assessing integration in flood risk management, with applications to England and Serbia uk.bl.ethods. 804151 | Middlesex |
| Miura, Maki | Effects of climate variability and extreme events on microbial activity in soils uk.bl.ethods.801337 | Bangor |
| Duncan, Niall | Mapping Scotland's hydropower resource uk.bl.ethods.630395 | Edinburgh |

# Flood Hydrology Road Map

Many of you will be aware of the Flood Hydrology Road Map project being run by the Environment Agency under the auspices of the Joint Flood and Coastal Erosion Risk Management (FCERM) Research and Development Programme, so I wanted to let you know what's currently happening on the project.

For those of you who haven't been so involved in the project, we're aiming to produce a vision for applied flood hydrology in the UK for the next 25 years, a prioritised list of the work areas needed to meet the vision and a delivery plan which will be used to guide future developments. It will cover both real-time forecasting and non-real-time 'design' applications of hydrology for all inland sources of flood risk (fluvial, surface water, groundwater and reservoir safety), addressing both direct operational needs and research requirements.

Although the project is being led by the Environment Agency, it is very much a collaboration involving hydrologists and others from the public sector, industry and academia from across the UK and elsewhere. Many of you will have submitted responses to online surveys and / or attended workshops – thank you for the ideas and support that you've contributed.

JBA Consulting were engaged by the Environment Agency last autumn to help support the project, running a workshop in Birmingham at the end of November. Since then, we've been working through the information and feedback that we got from the workshop. It probably won't surprise you to hear that with the repeated flood events over the winter following the workshop, and now the Covid-19 pandemic, we've not made as much progress as we'd expected. However, we do now have an overall vision statement, supported by individual vision statements for each of four themes: data, methods, scientific understanding and ways of working (see Fig.overleaf).

We're now working on revising the structure and interrelationships of the various work areas that were identified in earlier phases of the project, and the process to prioritise them. Once this is complete, we'll be asking the established 'Prioritisation Task Group' for further input to arrive at the set of work areas that need to be tackled to make the vision a reality and which will form the basis of the delivery plan.

**Mike Vaughan**
*Environment Agency*

## During the next 25-year period society will
## understanding to manage floo

### Scientific Ur

**We continually improve our understanding of the process**
**surface water, reservoir and groundwater) with state-of-the**
**practical improvements in the efficiency and effe**
**We understand links between flood hydr**

### Ways of Working

There is a representative UK group with a unifying overview as a lead voice for flood hydrology, to create more effective and efficient ways of working.

In the flood hydrology community, we work together with skilled teams and stakeholders, communicate clearly and use excellent, consistent technical guidance.

We engage across the UK and internationally, embracing and encouraging scientific and technological developments to continually improve efficiency and innovation in our field.

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## Leadership and collaboration are

## have improved hydrological information and od hazard in a changing world

### nderstanding

**es governing all areas of flooding risk (fluvial, fluvio-tidal, -art science. This science and knowledge is transferred into ectiveness of methods, ways of working and data. rology and related disciplines at all scales.**

### hods

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that are consistent,
peer reviewed.

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### Data

Funding, knowledge, capability and resources exist to monitor the UK hydrological environment; particularly extremes.

New and historical data are communicated and shared openly, properly archived and centrally located to support all flood hydrology studies. Data are freely available for all carrying out flood hydrology studies.

Data are of sufficient quantity and quality for each application; uncertainties are understood and communicated effectively.

**key to achievement of this vision.**

# Evidence of dramatic river network expansion in winter 2019-2020

**Over the winter, the seasonal expansion of groundwater-dominated river networks in parts of south east England was particularly dramatic.**



Hamble |Brook at Watery Lane, Fingest (top) and Hambleden Village (bottom) in Buckinghamshire, Nov/Dec 2019 (left) and Apr 2020 (right)
[Photos: David Boorman and Catherine Sefton]

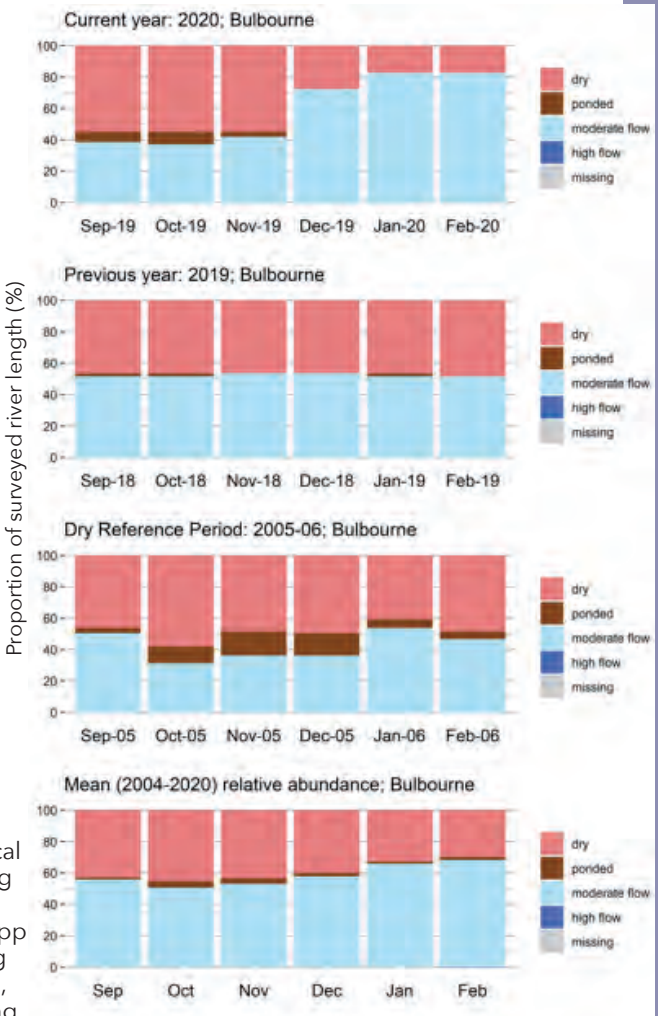
The Hamble Brook in Buckinghamshire, for example, which was dry in its upper and lower reaches at the end of 2019 and indeed all last year, was instead flowing along its length by the spring. The contrast with previous years is apparent on the River Bulbourne in Hertfordshire – see diagram opposite.

Over the winter, the proportion of surveyed river length that was observed to be flowing (blue) doubled from 40 to 80% (top panel). The other three panels in turn show the same months in the previous year, a dry reference period and averaged over the longer term. The network expansion was greater and more rapid than on average, and in marked contrast to last year, when failure of the winter recovery maintained a length of dry channel comparable with that seen during the drought of 2005-2006. Data were collected by Herts and North London Area of the Environment Agency and

visualised by the UK Centre for Ecology & Hydrology.

If you live near a temporary river, say in Yorkshire, Lincolnshire, Wessex, the peat uplands, the South Downs or elsewhere, why not take a walk or a bike ride to track down its source? It might have moved since you last saw it!

Remember that citizen science monitoring activities like these are at your own risk, so do stay safe - observe any government restrictions, take care around traffic and livestock, wear suitable clothing and footwear for the weather and terrain, and don't be tempted into water or onto private property. You can log the hydrological condition of sites along a river on the citizen science website and app CrowdWater, choosing from dry bed, wet bed, isolated pools, standing water, trickling water or flow. More information at https://crowdwater.ch/en/data/ or from Catherine Sefton at UKCEH (catsef@ceh.ac.uk).




*Catherine Sefton,*
*with due acknowledgement to Simon Parry, Michael Eastman and David Boorman of UKCEH and to Herts and North London Area of the Environment Agency.*

**The annual meeting on Temporary Rivers and Streams hosted by Nottingham Trent University is on 23 June 2020 and will go ahead online – more details at https://www.eventbrite.co.uk/e/temporary-rivers-and-streams-2020-tickets-97779588381**

# UK Hydrological Bulletin: February – April 2020

**Volatility is an inherent characteristic of the UK climate but the February—April 2020 period was a truly remarkable hydrological episode with extreme rainfall accumulations over the first six weeks followed, in many areas, by notably arid conditions. February was the wettest on record for the UK in the Met Office series from 1862 and, more remarkably, the rainfall accumulation from June 2019-February 2020 is the highest for any nine-month sequence (Fig 1). Flooding during February and early March was severe, extensive and, in many areas, very persistent. Impacts on the community were exceptional and protracted, testing the resilience of flood alleviation measures, planning regulations, the transport network and agriculture to extreme climatic events. A positive aspect was the abundant late-winter replenishment of surface and groundwater resources — entering March, most reservoirs were close to capacity and near-record groundwater levels characterised many aquifer units across the country. Thereafter however, the UK's third driest March—April since 1984, together with seasonally high temperatures, resulted in soil moisture deficits increasing sharply. Correspondingly, some groundwater-fed rivers apart, river flows decreased steeply, echoing 2003, 1995 and 1990 and providing modern reminders of how rapidly the water resources outlook can deteriorate through the spring.**

February was an extremely cyclonic month and the passage of storms Ciara, Dennis and Jorge contributed to outstanding rainfall totals across most of the country. For the UK as a whole, only three individual months have registered higher rainfall totals in the Met Office's national series. Much the greater part of the country recorded more than twice the average rainfall with particularly extreme accumulations across most of northern England, the Midlands and North Wales (Fig. 2).

On the 8/9th 24hr rainfall totals of 126 mm and 123 mm were recorded at Shap (Cumbria) and Capel Curig (north Wales) respectively and, by the evening, over 220 Flood Warnings and 270 Flood Alerts were in operation across

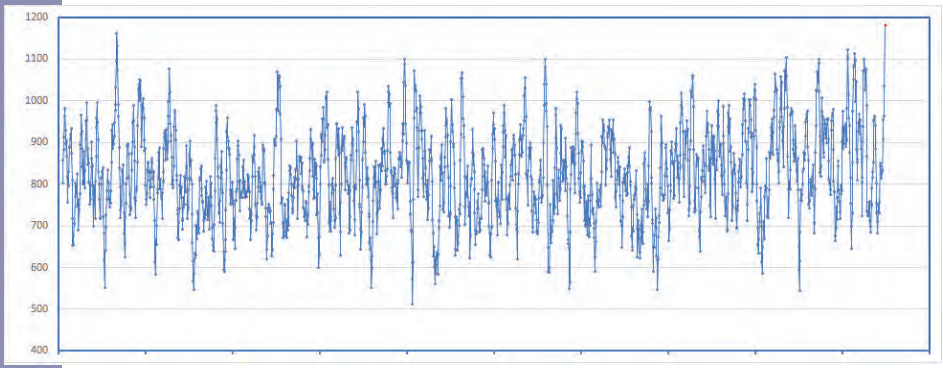



**Fig 1** UK rainfall 9-month running mean (mm). Data source: Met Office

England & Wales with over 60 Flood Warnings in Scotland (tidal warnings making up a proportion of both). Damaging winds contributed to extensive transport disruption and power outages.

A week later and, with rivers still in high spate, storm Dennis brought very wet and seasonally mild conditions (in upland regions, snowmelt added to the already high flood risk). A storm rainfall total of 142 mm was recorded at Cray Reservoir in the Brecon Beacons and severe flooding occurred in many areas including south Wales (e.g. at Pontypridd) and in Worcestershire where parts of Tenbury Wells were evacuated.

Overall, runoff from the UK was outstanding during the third week and outflows from England & Wales eclipsed the previous daily maxima in a 60-year series (Fig. 3). Correspondingly, by early on the 17th over 300 Flood Warnings and 350 Alerts (fluvial and tidal) – both remarkable totals – were in operation across England & Wales; warnings were extensive in Scotland also.

An estimated 3,300 properties were flooded in England by the two storms but substantially fewer than during the widespread flooding during the winter 2015/16. Importantly, it is estimated that over 120,000 properties in England were protected by flood defences; demountable barriers made a valuable contribution. Storm Jorge near month-end served to emphasise a further dimension to the flooding – sustained high river levels limiting

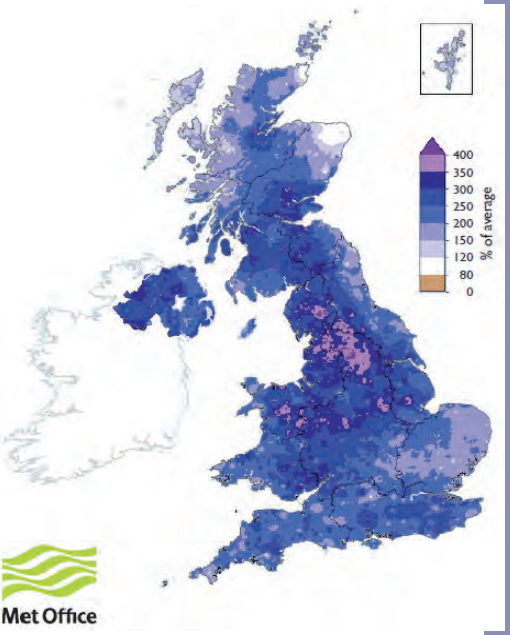



**Fig. 2** February 2020 rainfall as a % of the 1981–2010 average

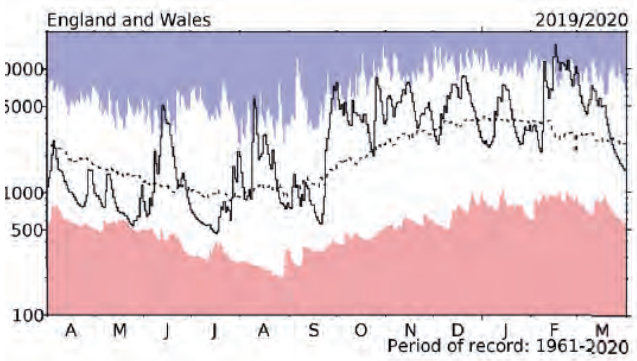



**Fig. 3** Daily outflows ($m^3s^{-1}$) from England & Wales (black trace), the blue and pink envelopes are the daily max. and min. flows; the dotted trace is the long-term daily mean (in a series from 1961)

the return of floodplain waters and exacerbated the crop damage for farmers and growers.

February runoff totals exceeded previous maxima for most index catchments in northern England and across much of the Midlands and Wales; in Northern Ireland the river Mourne also exceeded its previous maximum. For England as a whole the February runoff was the highest for any month in a 60-year series. Correspondingly, almost all index reservoirs were close to capacity and, generally, the abundant winter recharge fuelled a steep rise in groundwater levels. Most index boreholes were at, or close to, historical maxima by late February but aquifer characteristics were also influential: entering March levels in the deep Chalk well at Therfield remained well below the late-winter average.

The UK rainfall total for March was 84% of average but many areas experienced substantially drier conditions. Generally, the greatest deficiencies were in eastern catchments; the Anglian region registered only marginally more than half of the monthly average. However, further rainfall in the wake of Storm Jorge ensured that over 100 Flood Warnings and over 200 Alerts were in operation on the 1st, with the flood threat increasingly focused on the lower reaches of major rivers. An index of the exceptional persistence of floodplain inundation is provided by Worcestershire County Cricket ground – under water for around half of a nineteen-week sequence. An active Atlantic front brought further heavy rainfall on the 8th; on Skye a 36-hr total of 128 mm was recorded but thereafter, high pressure was re-established and the associated arid episode continued well into May. Whilst many rivers registered notably high March runoff totals, recessions over the second half of the month were remarkably steep. Particularly depressed month-end flows were recorded in eastern catchments in Northern Ireland and Scotland. By contrast, groundwater levels, benefitting from outstanding aquifer recharge over the November 2019–February 2020 period remained exceptionally high in many outcrop areas including the Lincolnshire Limestone (Fig. 4). Correspondingly, notably high flows characterised many rivers draining permeable catchments, particularly in southern England. In Dorset, March runoff for the river Stour approached twice the average and, generally, the focus of flooding concern switched to rivers with baseflow-dominated regimes. Contrary to normal seasonal trend, overall reservoir stocks for England & Wales declined through March but the great majority of index reservoirs remained close to their end-of-month average.

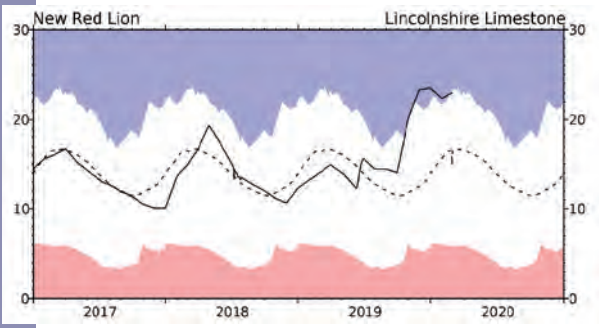



**Fig. 4** Monthly groundwater levels for the New Red lion borehole. The blue and pink envelopes are the daily max. and min. levels; the dotted trace is the long-term mean

April was another dry month – the second driest since 1980 for the UK and the third driest on record for Scotland. The month was also the sunniest on record for the UK. A few areas in central southern England recorded above average rainfall but large rainfall deficiencies extended in a broad zone from the Humber basin to the Forth estuary. In Northumberland, Morpeth registered its lowest April rainfall total in a 126-year series. The meagre rainfall, notably high temperatures and an associated rapid increase in evaporative demands resulted in a corresponding increase in soil moisture deficits. Some locally intense storms on the 18th (e.g. on Canvey Island) triggered very local spates but generally arid soil conditions ensured that river flow recessions in most impermeable catchments continued well into May. Notably low April runoff total were recorded across much of northern England (e.g. for the rivers Lune and Swale) and parts of eastern Scotland (including the Earn and Tweed). By contrast, the continuing benefit of the exceptional winter recharge ensured that many groundwater-fed rivers and streams remained close to, or above, bankfull. Entering the fourth week 15 Flood Alerts remained in operation, mostly for rivers draining from the southern Chalk and Jurassic Limestone outcrops (see previous item). In the Chilterns, the Hamble Brook was flowing in its upper reaches - contrasting dramatically with the dry stream bed of the early winter (Fig 5) - and flows in many intermittent streams extended high into their headwaters.

*Terry Marsh*

**For further information see UKCEH report: https://nrfa.ceh.ac.uk/sites/default/files/Briefing_Note_V6.pdf**





**Fig. 5** Early winter (Dec 2019) and late April photos of the Riv er Hamble

Photos: David Boorman and Cath Sefton

