Hydrological Summary
for the United Kingdom

February 2024

General

February was mild and wet, notably and unchangeably so in the south, whilst the north saw a cold spell mid-month. It was the warmest February on record for both England and Wales (in series from 1890), and the second warmest in the long Central England temperature series (of 365 years). Rainfall was at least twice the February average across central and southern England and more than three times around the Wash. River flows were average in the north, and above average in the south, with sustained incursions into the maximum daily flow envelope on some baseflow-dominated rivers. Soils were saturated across most of the UK, and groundwater levels were widely notably or exceptionally high. Reservoir stocks were healthy at the national scale (at least 95 percent of capacity for Scotland, Northern Ireland and England & Wales), although deficits remained at some impoundments (Grafham, Celyn & Brenig and Daer) and developed at Farmoor. The outlook for the spring months (March-May) is for normal to above normal river flows and, in places, notably or exceptionally high groundwater levels. With reservoir stocks close to capacity, there is little concern for water resources, but where rainfall at the start of March has kept soils very wet, the elevated risk of flooding will continue until soils begin to dry out.

Rainfall

February began unsettled with heavy rain affecting Scotland on the 4th and 5th (103mm were recorded at Achnagart on the 5th). From 6th-9th northerly airflows brought snow and ice to Scotland, Northern Ireland, northern England, and Wales, with some road closures reported. In the south, by contrast, conditions were mild with persistent rain, and by the 10th, over 400 flood alerts and flood warnings were in force, predominantly across the Midlands and southern England. Continued unsettled conditions from a succession of westerly low pressure systems kept soils wet, and brought heavy frontal rain on the 17th (87mm were recorded at White Barrow, Devon) which caused flooding of roads in the Midlands and the east of England, and disruption of rail travel between London and the west and south-west of the UK. Low pressure systems brought further rain from 20th-22nd, with disruption to road and rail transport in the West Midlands, and conditions continued unsettled to month-end. Total February rainfall was 145% of average for the UK. There was a stark geographical gradient, with normal rainfall for Scotland and Northern Ireland, whilst England saw its fourth wettest February on record (in a series from 1890). The winter months (December to February) were amongst the wettest on record (ranking in the top three) for Orkney, Anglian and Yorkshire regions, and for England, the five months from October-February were the wettest on record (all in series from 1890).

River Flows

River flow recessions at the end of January brought flows close to average at the start of February, before rising again to a peak on rivers in Scotland and Northern Ireland on the 5th, and England and Wales on the 9th-10th. The Warwickshire Avon, notable for its long record (from 1937), established a new February peak flow maximum on the 9th. In Scotland, flows then returned and remained close to average, with moderate responses to rainfall until month-end. In England and Wales, by contrast, flows were sustained above average by responses on the 14th-15th and the 17th-18th. Further increases from 21st-23rd resulted in high-ranking February peak flows (top five in records of 50 years or more) on rivers in England and Wales, in the west (e.g. Tawe) and on baseflow-dominated flow regimes (e.g. Little Ouse, Coln). February flows were normal or above normal in Scotland, Northern Ireland and north-west England, and notably or exceptionally high elsewhere. In the east and south-west, many rivers recorded flows between two and three times their February average (e.g. Wensum, Bedford Ouse, Exe) with new maxima established for February on the Stringside and Brue (all in series of 50 years or more), and for any month on the Warwickshire Avon (in a long series from 1937). Across the winter months (December-February), river flows were above average, many exceptionally so, with new records seen across these three months (and also the five months from October). Accordingly, outflows from England approached maxima established in previous winters notable for groundwater flooding (2013-2014 and 2000-2001, across the same three- and five-month periods respectively).

Soil Moisture and Groundwater

At the end of February soil moisture was high or above field capacity. Groundwater levels were exceptionally high at the majority of sites (20 of the 32 reported) with record levels at seven sites, and there were groundwater flood alerts across large areas of southern England. Across the Chalk, levels rose at most sites and February maxima were recorded at Houndean Bottom, Ashton Farm and Dial Farm. At the latter, where a new record was established (for any month, in a series of 56 years), levels rose by over a metre and moved from above normal to exceptionally high. At Chilgrove House, levels rose by over 10 meters and moved from above normal to exceptionally high. An exception to this pattern was Killyglen where levels remained in the normal range. Levels in the Jurassic limestones rose at New Red Lion by over 1.5 metres and ended the month with a new maximum for February (in a 60-year record). At Ampney Crucis, levels also rose and moved from normal to exceptionally high. Levels in the Magnesian Limestone remained exceptionally high at both Aycliffe and Brick House Farm. At Brick House Farm, they rose by over 0.5 metre to establish a new record for any month (in a series of 44 years). In the Carboniferous Limestone at Alstonfield, levels rose by about 3 metres moving from above normal to notably high. At Pant-y-Lladron, levels rose by almost 2 metres (establishing a new maximum for any month in a series of 29 years) and moved from normal to exceptionally high. In the Permo-Triassic Sandstones, levels remained notably high at Skirwith, while at both Llanfair DC and Bussels No.7a, they rose and moved from above normal to notably high. Exceptionally high levels persisted in the Upper Greensand at Lime Kiln Way and reached a new maximum for February (in a 55-year record). In the Devonian sandstones, levels remained in the normal range, both at Easter Lathrisk and Feddan Junction. In the Fell Sandstone at Royalty Observatory, levels rose slightly and ended the month in the notably high range.

National Hydrological Monitoring Programme | UK Centre for Ecology & Hydrology | BGS British Geological Survey

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1991-2020 average.

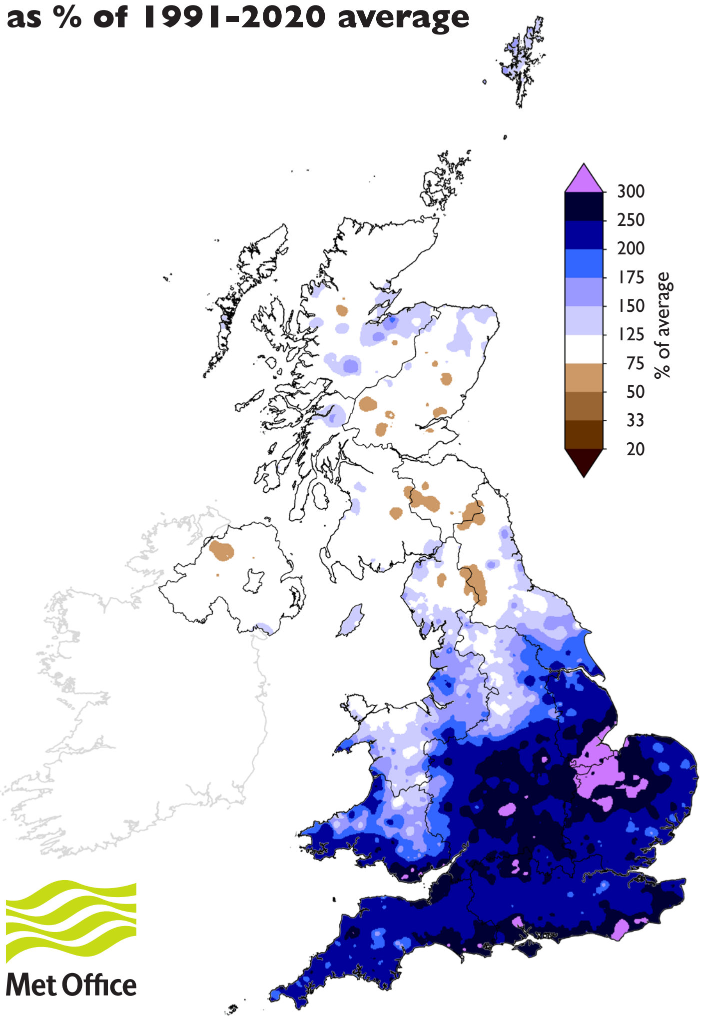
Region	Rainfall	Feb 2024	Jan24 – Feb24	RP	Dec23 – Feb24	RP	Oct23 – Feb24	RP	Mar23 – Feb24	RP
United	mm	**140**	257		446		736		1378	
Kingdom	%	**145**	118	5-10	130	20-30	125	50-80	119	60-90
England	mm	**130**	215		360		618		1154	
	%	**196**	144	15-25	150	30-50	147	>100	134	>100
Scotland	mm	**149**	314		560		881		1619	
	%	**106**	99	2-5	114	5-10	107	5-10	103	5-10
Wales	mm	**206**	368		626		1009		1827	
	%	**171**	133	8-12	140	15-25	132	30-50	126	50-80
Northern	mm	**85**	171		340		624		1443	
Ireland	%	**92**	83	2-5	104	2-5	111	8-12	125	>>100
England &	mm	**140**	236		396		671		1246	
Wales	%	**191**	142	10-20	148	30-50	144	80-120	132	>100
North West	mm	**138**	301		531		842		1639	
	%	**131**	130	10-15	141	30-50	131	50-80	129	>100
Northumbria	mm	**67**	165		318		594		1103	
	%	**95**	108	2-5	130	10-20	139	>100	122	25-40
Severn-Trent	mm	**118**	184		331		567		1066	
	%	**204**	142	8-12	158	30-50	154	>100	134	>100
Yorkshire	mm	**97**	198		360		613		1146	
	%	**141**	134	5-10	152	30-50	150	>100	132	80-120
Anglian	mm	**106**	157		248		446		850	
	%	**251**	165	30-50	164	50-80	161	>>100	136	>100
Thames	mm	**127**	196		301		521		1007	
	%	**240**	157	15-25	153	20-30	149	30-50	140	80-120
Southern	mm	**158**	238		357		679		1153	
	%	**250**	158	15-25	147	15-25	157	50-80	141	80-120
Wessex	mm	**166**	253		412		703		1300	
	%	**243**	155	15-25	157	25-40	152	60-90	144	>100
South West	mm	**239**	351		563		907		1639	
	%	**224**	143	10-15	143	15-25	134	25-40	131	60-90
Welsh	mm	**201**	355		600		971		1762	
	%	**176**	135	8-12	141	20-30	132	30-50	126	50-80
Highland	mm	**196**	409		685		1024		1810	
	%	**111**	103	2-5	113	5-10	103	5-10	97	2-5
North East	mm	**88**	196		386		724		1266	
	%	**111**	109	2-5	138	20-35	141	>100	119	80-120
Tay	mm	**110**	261		494		889		1588	
	%	**92**	92	2-5	114	5-10	122	15-25	114	20-30
Forth	mm	**101**	231		427		717		1339	
	%	**93**	95	2-5	114	5-10	114	10-20	108	10-15
Tweed	mm	**74**	195		372		623		1193	
	%	**84**	99	2-5	119	8-12	116	10-20	110	10-15
Solway	mm	**136**	286		551		777		1623	
	%	**101**	94	2-5	115	5-10	95	2-5	103	5-10
Clyde	mm	**186**	352		638		975		1867	
	%	**108**	91	2-5	106	5-10	97	2-5	99	2-5

% = percentage of 1991-2020 average *RP = Return period*

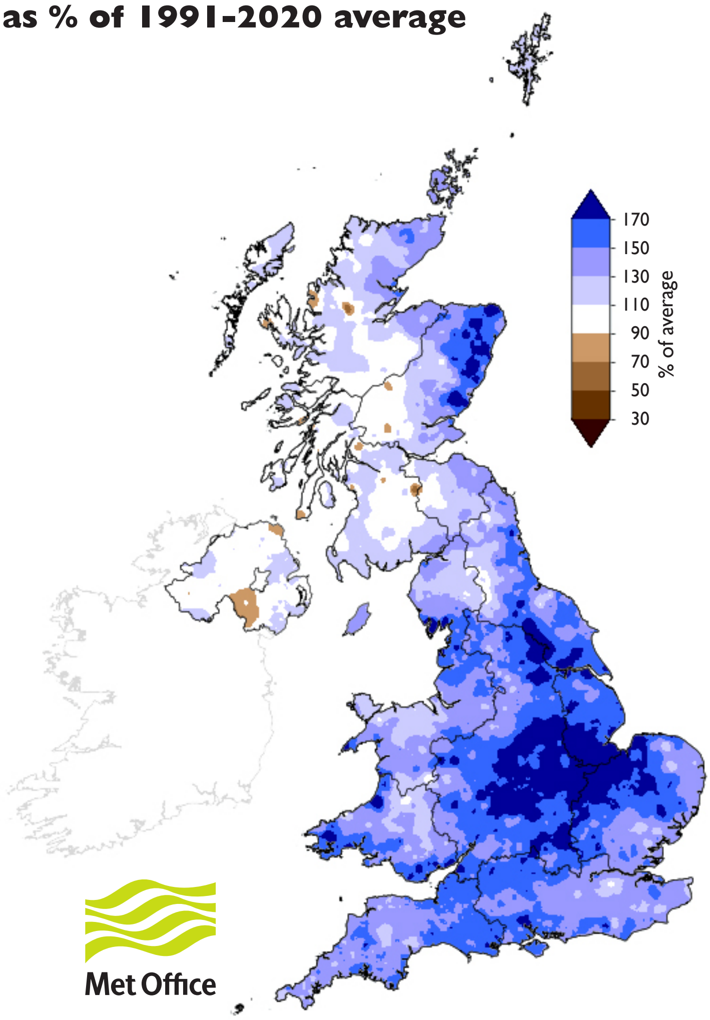
Important note: Figures in the above table may be quoted provided their source is acknowledged. Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1890; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals since January 2023 are provisional. Source: Data from HadUK-Grid dataset at 1km resolution v1.2.0.0.

Rainfall . . . Rainfall . . .

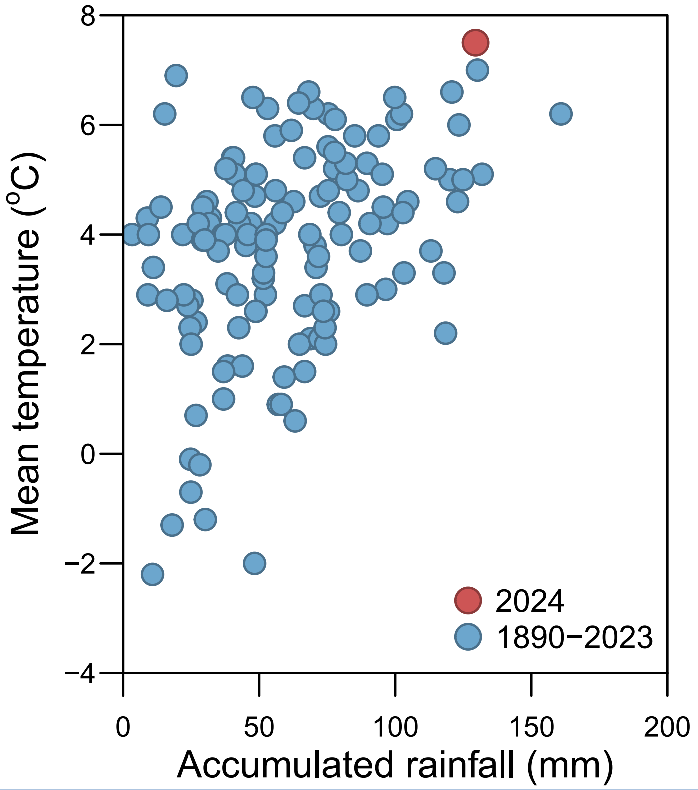
February 2024 rainfall as % of 1991-2020 average



December 2023 - February 2024 rainfall as % of 1991-2020 average



February rainfall and mean temperature for England 1890-2024



UK Hydrological Outlook

The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

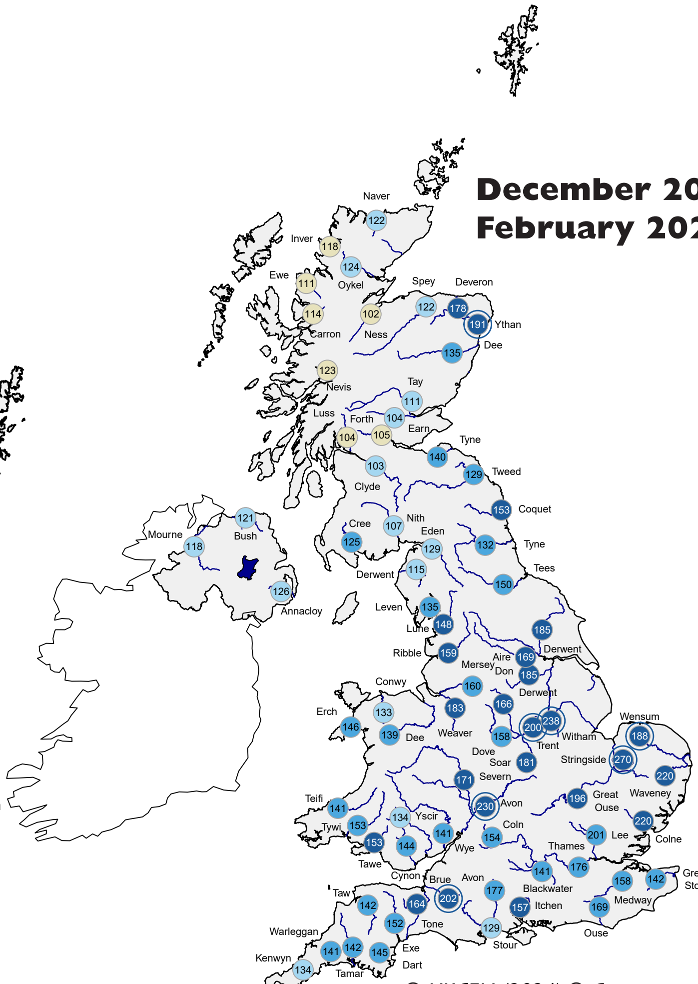
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from March 2024**
Issued: **08.03.2024**
using data to the end of February 2024

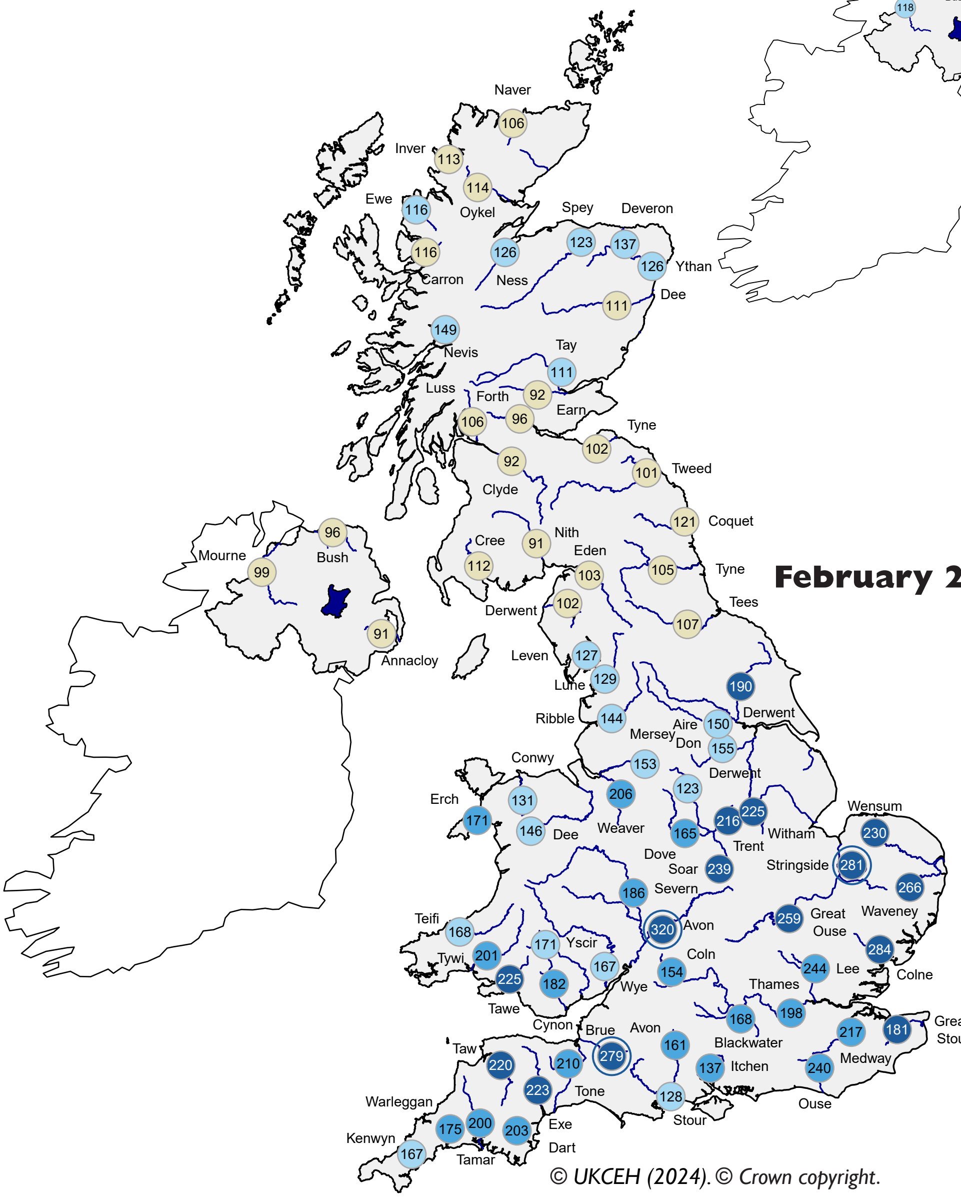
The outlook for March is for above normal flows to persist in central, southern and eastern England, and these areas are likely to see normal to above normal flows over the March-May period. In the north and west, normal flows are most likely in March and for March-May. For groundwater levels, above normal levels are likely to persist for most of the UK through March, and for the March-May period in many aquifer areas.

River flow . . . River flow . . .

December 2023 - February 2024



February 2024



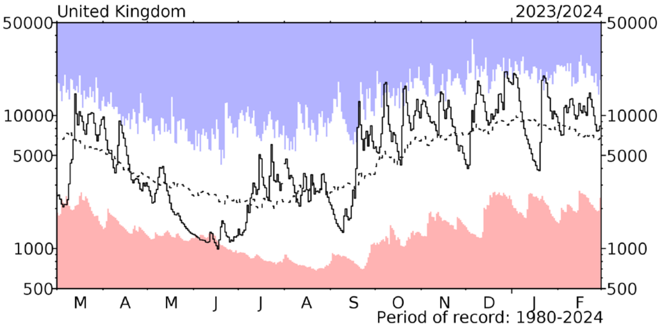
Key

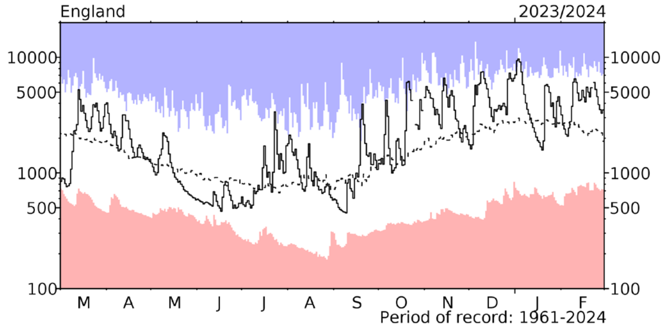
- 25 — % of 1991−2020 average (record high/low when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

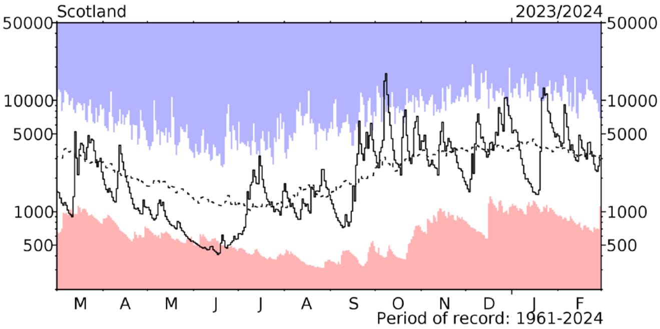
*Based on period−of−record ranking of the monthly flow**

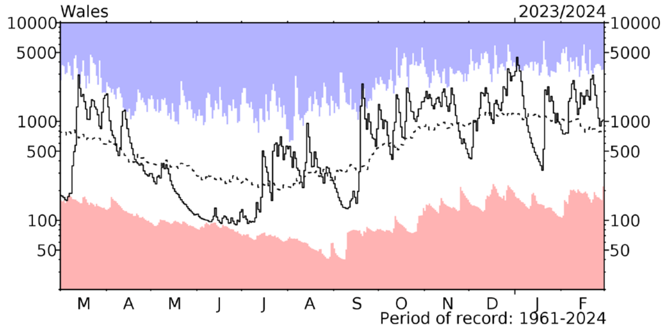
River flows

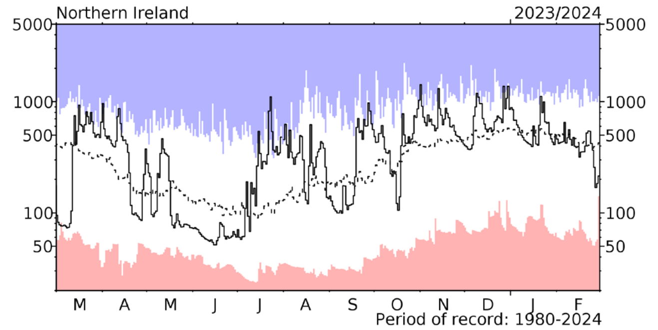
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. The categories of the spots are based on the full period-of-record data whereas the percentages are based on the 1991-2020 averaging period for consistency between rainfall and river flows. Percentages may be omitted where flows are under review.

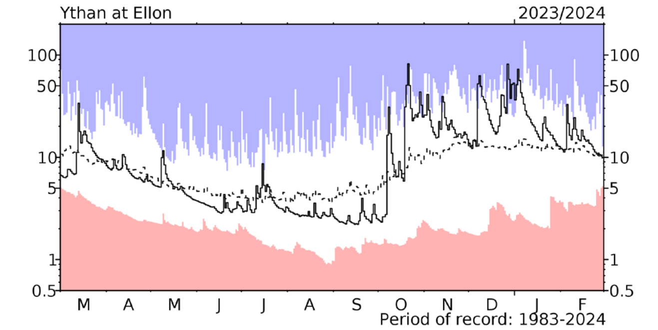


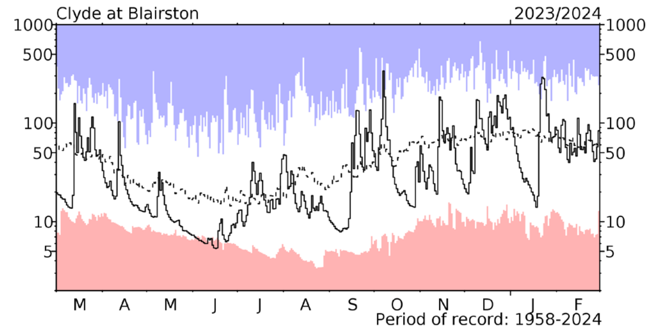


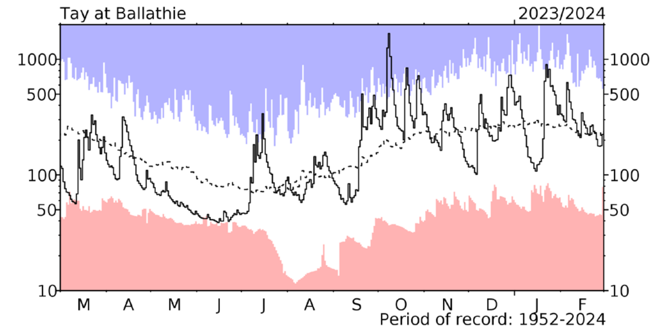


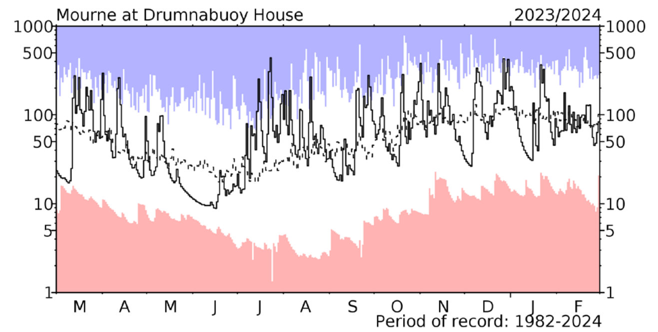


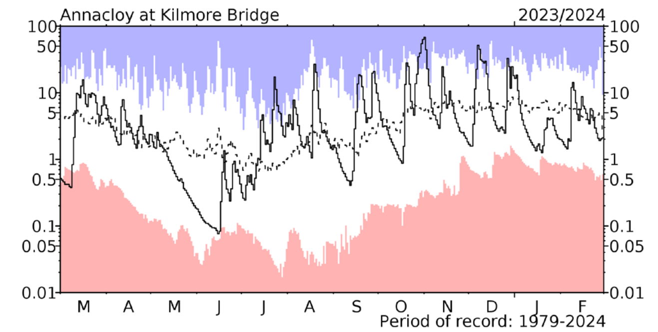






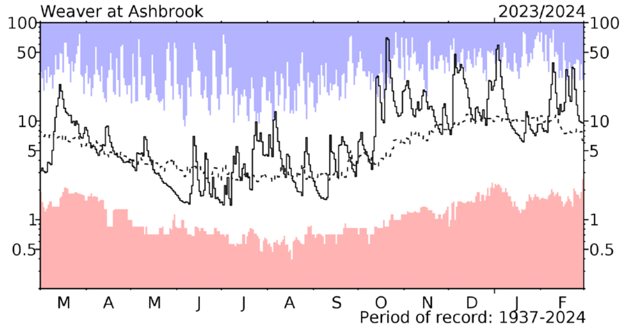


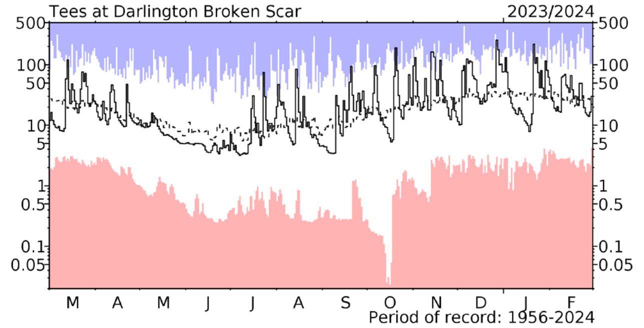


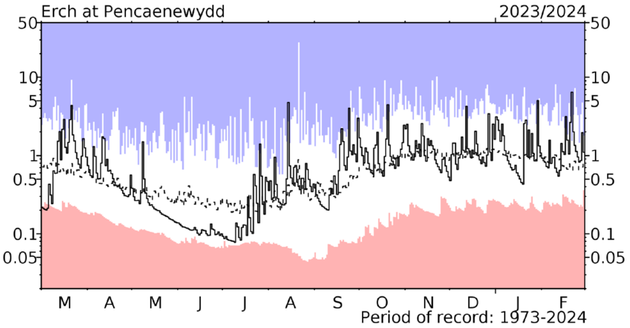


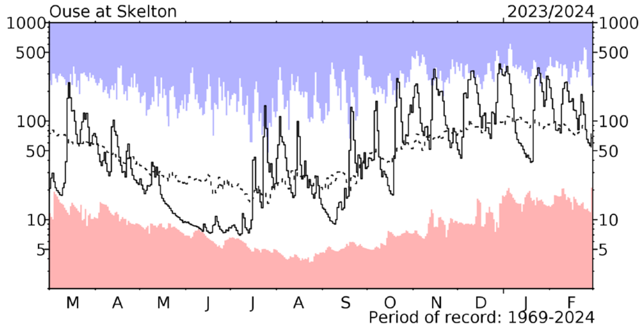
River flow hydrographs

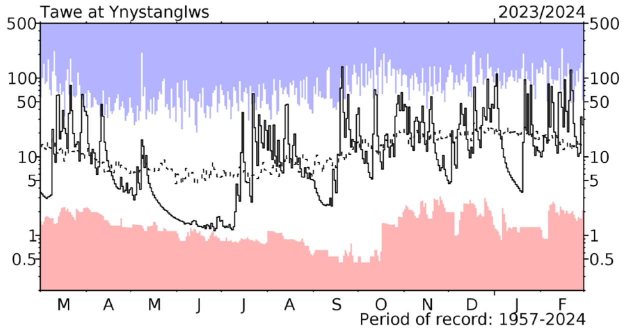
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to February 2023 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

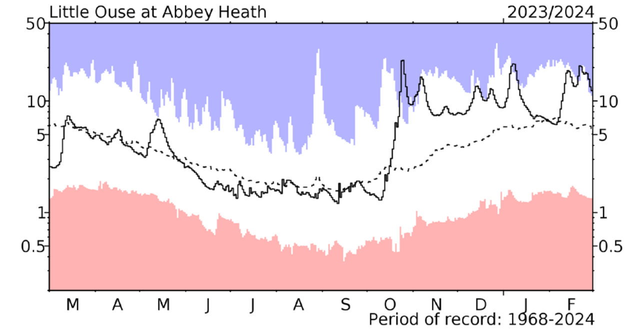

Weaver at Ashbrook
2023/2024
M A M J J A S O N D J F
Period of record: 1937-2024

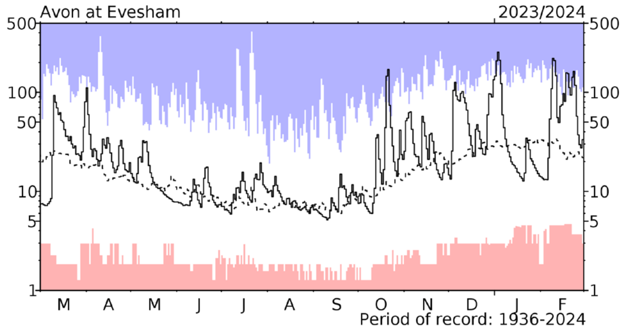

Tees at Darlington Broken Scar
2023/2024
M A M J J A S O N D J F
Period of record: 1956-2024

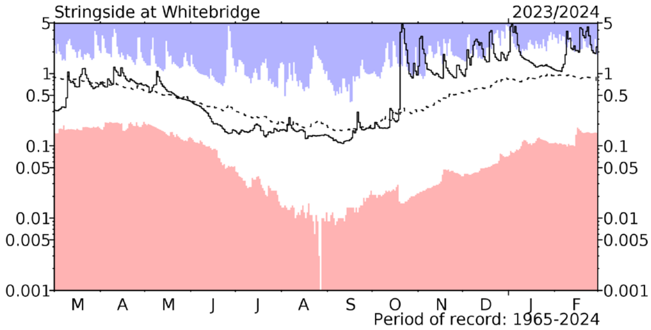

Erch at Pencaenewydd
2023/2024
M A M J J A S O N D J F
Period of record: 1973-2024

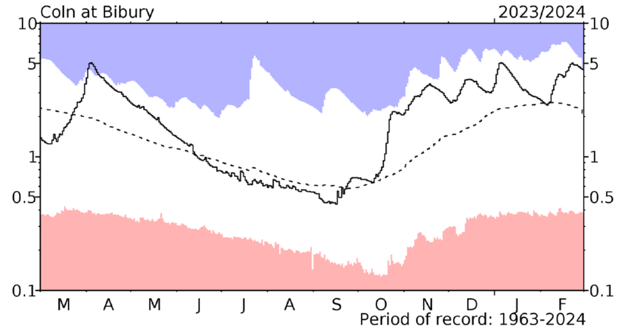

Ouse at Skelton
2023/2024
M A M J J A S O N D J F
Period of record: 1969-2024

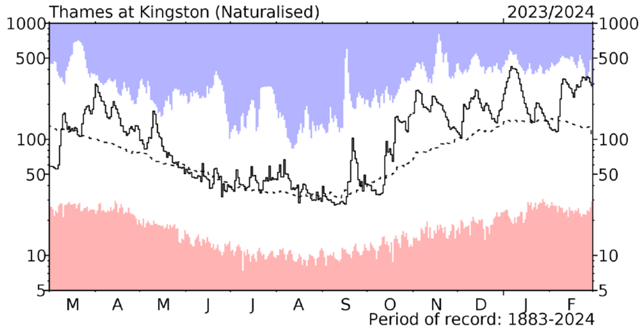

Tawe at Ynystanglws
2023/2024
M A M J J A S O N D J F
Period of record: 1957-2024

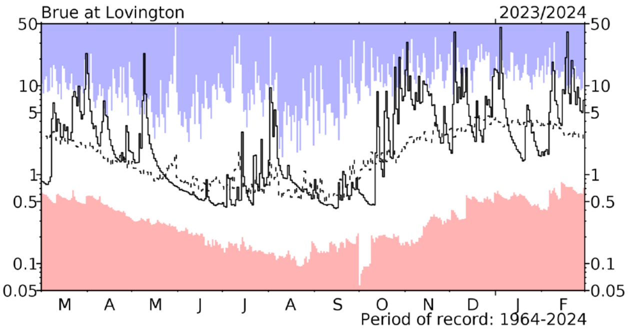

Little Ouse at Abbey Heath
2023/2024
M A M J J A S O N D J F
Period of record: 1968-2024

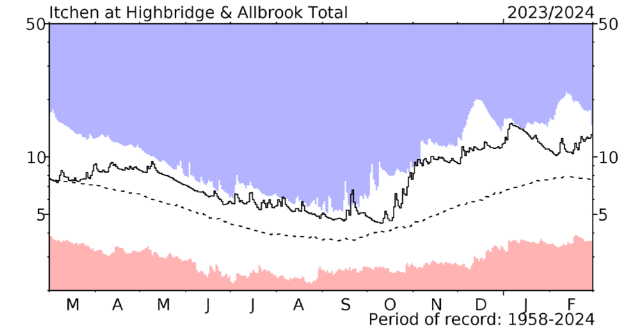

Avon at Evesham
2023/2024
M A M J J A S O N D J F
Period of record: 1936-2024


Stringside at Whitebridge
2023/2024
M A M J J A S O N D J F
Period of record: 1965-2024

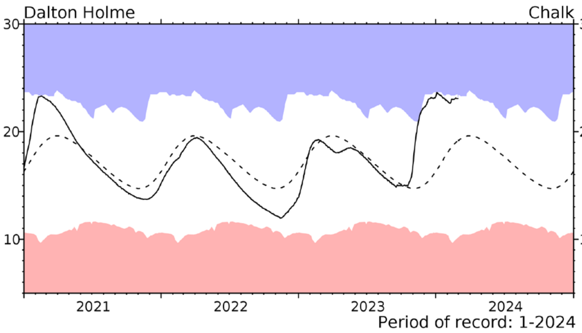

Coln at Bibury
2023/2024
M A M J J A S O N D J F
Period of record: 1963-2024

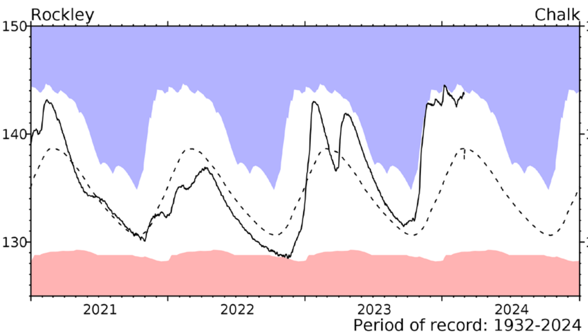

Thames at Kingston (Naturalised)
2023/2024
M A M J J A S O N D J F
Period of record: 1883-2024

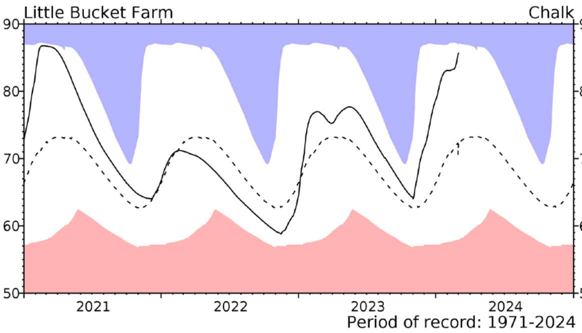

Brue at Lovington
2023/2024
M A M J J A S O N D J F
Period of record: 1964-2024

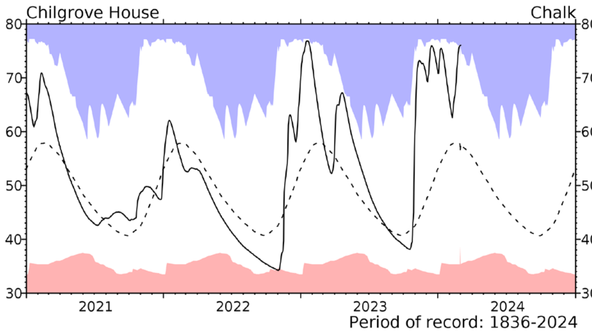

Itchen at Highbridge & Allbrook Total
2023/2024
M A M J J A S O N D J F
Period of record: 1958-2024

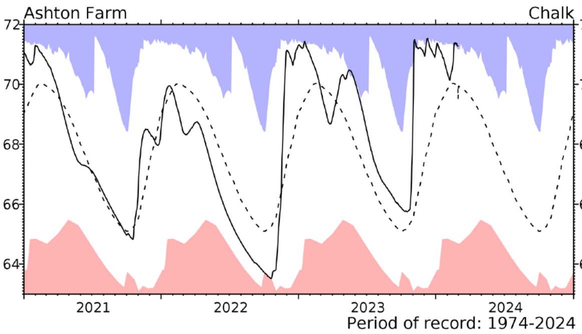
Groundwater . . . Groundwater

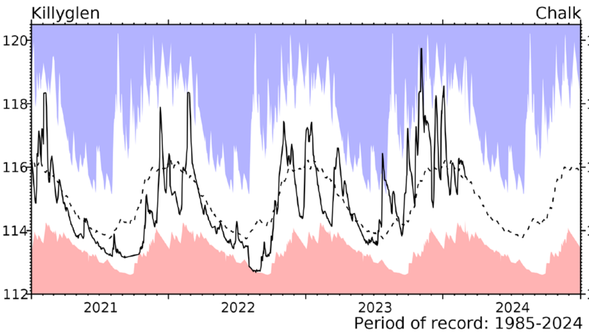


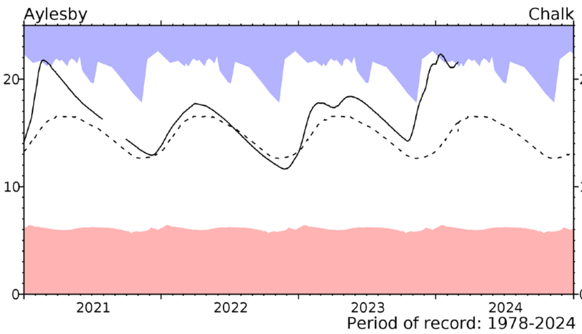


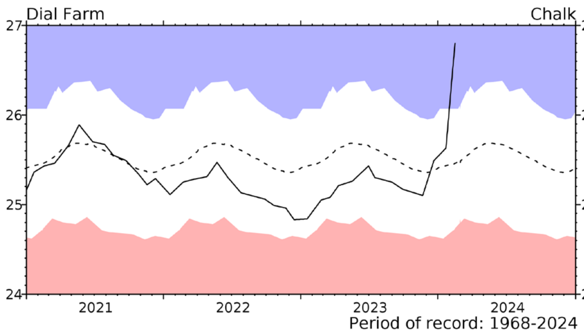


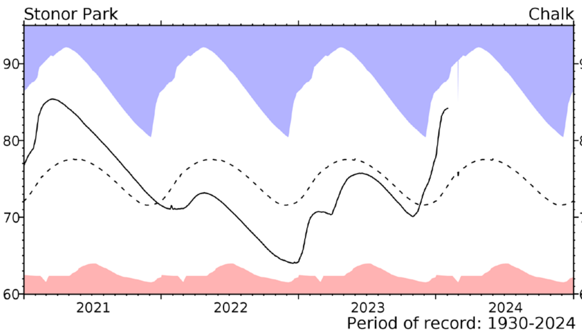


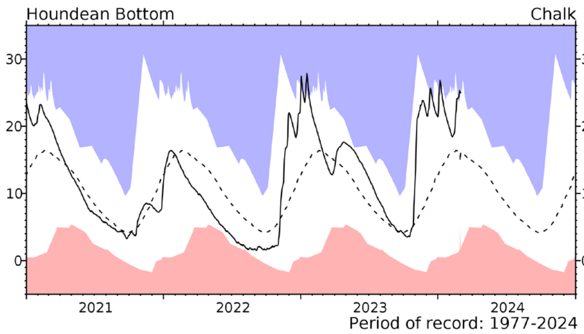




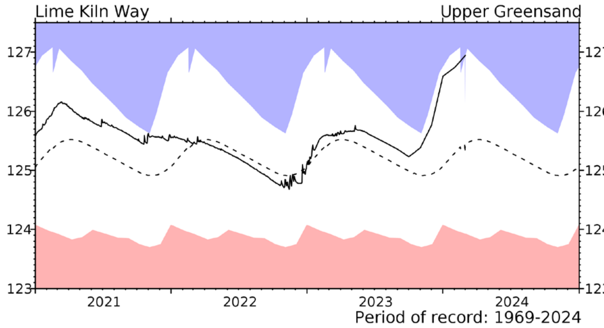


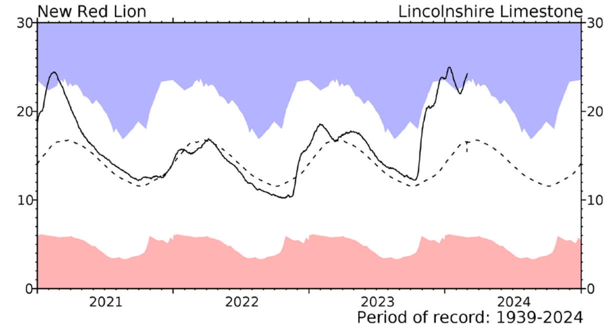


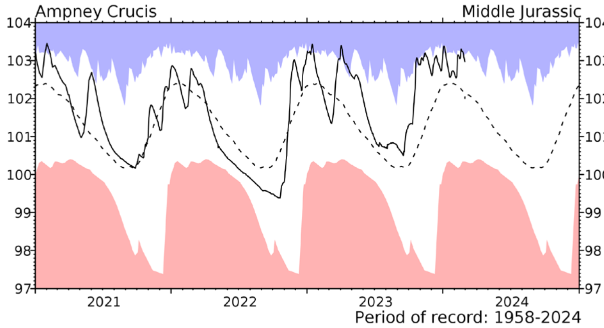


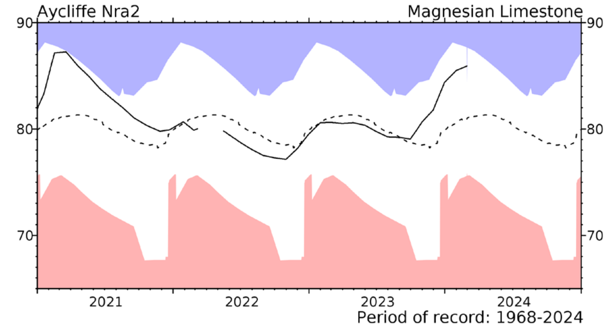


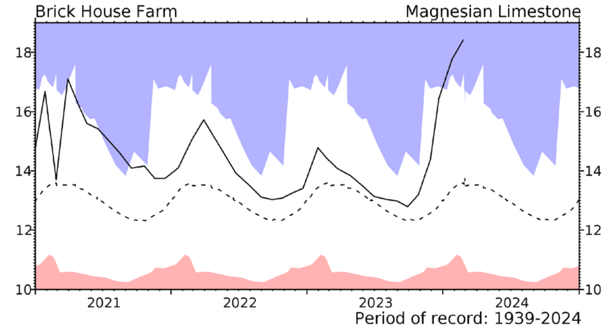
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month are calculated with data from the start of the record to the end of 2020. Note that most groundwater levels are not measured continuously and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation.

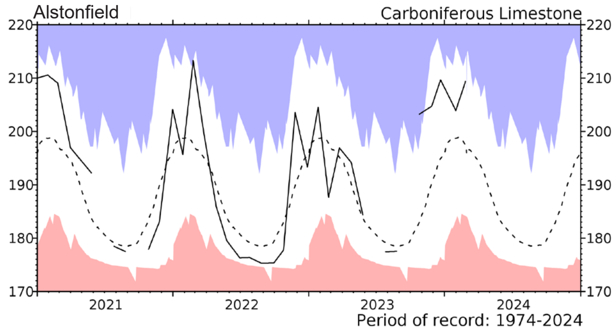

Lime Kiln Way
Upper Greensand
127 126 125 124 123
2021 2022 2023 2024
Period of record: 1969-2024

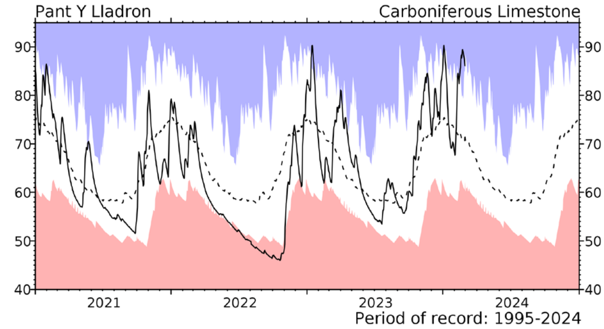

New Red Lion
Lincolnshire Limestone
30 20 10 0
2021 2022 2023 2024
Period of record: 1939-2024

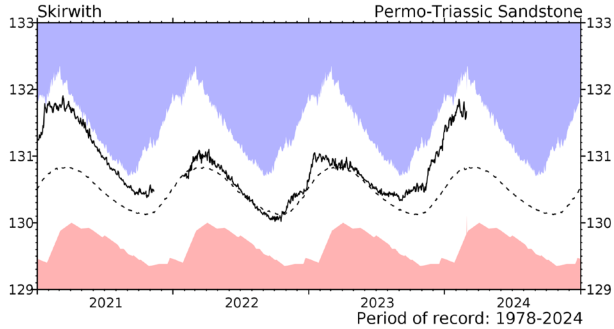

Ampney Crucis
Middle Jurassic
104 103 102 101 100 99 98 97
2021 2022 2023 2024
Period of record: 1958-2024

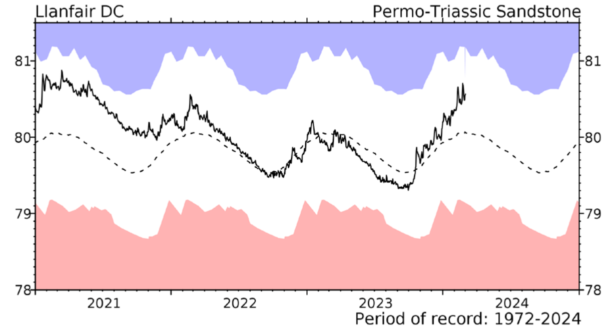

Aycliffe Nra2
Magnesian Limestone
90 80 70
2021 2022 2023 2024
Period of record: 1968-2024

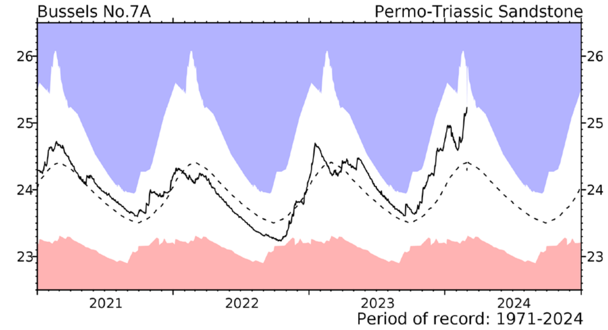

Brick House Farm
Magnesian Limestone
18 16 14 12 10
2021 2022 2023 2024
Period of record: 1939-2024

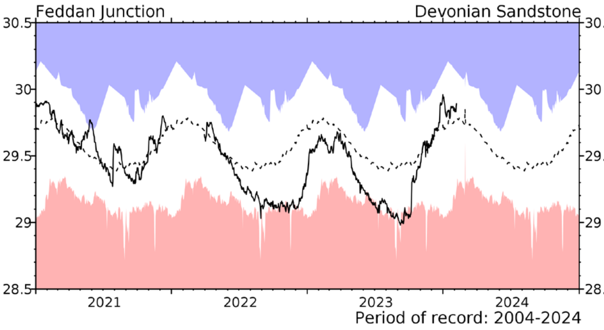

Alstonfield
Carboniferous Limestone
220 210 200 190 180 170
2021 2022 2023 2024
Period of record: 1974-2024

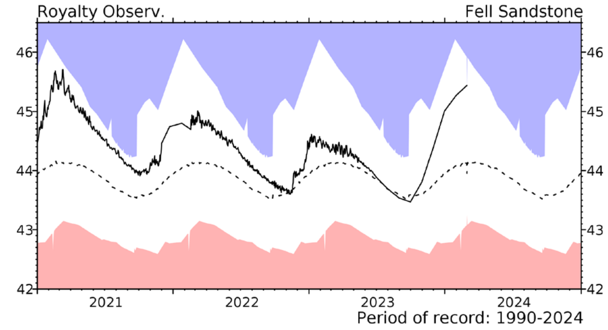

Pant Y Lladron
Carboniferous Limestone
90 80 70 60 50 40
2021 2022 2023 2024
Period of record: 1995-2024


Skirwith
Permo-Triassic Sandstone
133 132 131 130 129
2021 2022 2023 2024
Period of record: 1978-2024

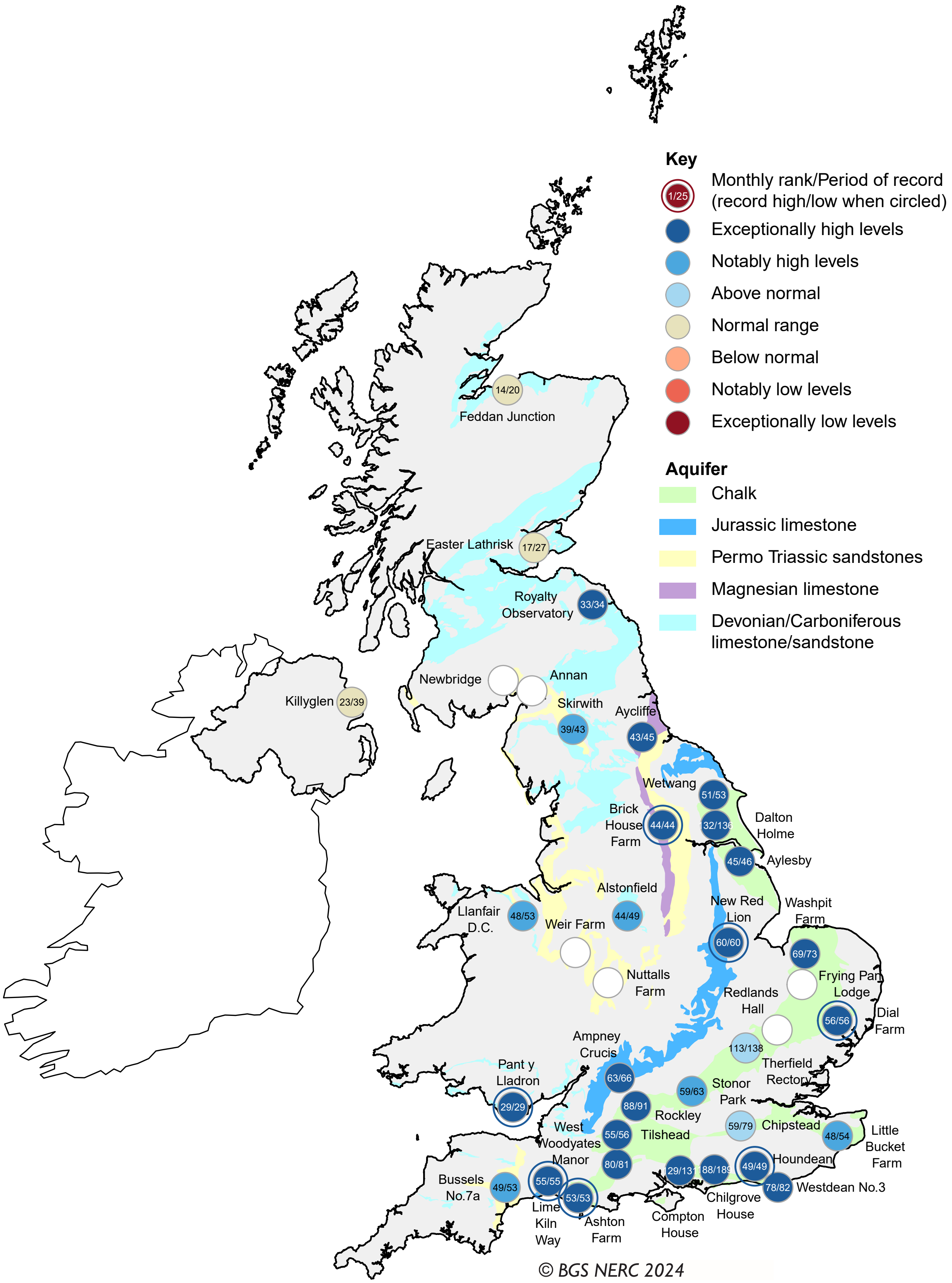

Llanfair DC
Permo-Triassic Sandstone
81 80 79 78
2021 2022 2023 2024
Period of record: 1972-2024


Bussels No.7A
Permo-Triassic Sandstone
26 25 24 23
2021 2022 2023 2024
Period of record: 1971-2024


Feddan Junction
Devonian Sandstone
30.5 30 29.5 29 28.5
2021 2022 2023 2024
Period of record: 2004-2024


Royalty Observ.
Fell Sandstone
46 45 44 43 42
2021 2022 2023 2024
Period of record: 1990-2024

Groundwater . . . Groundwater

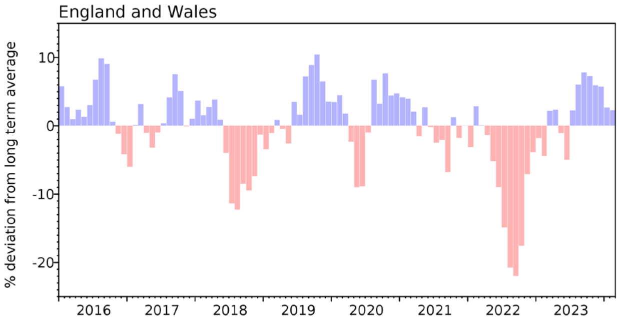


Groundwater levels - February 2024

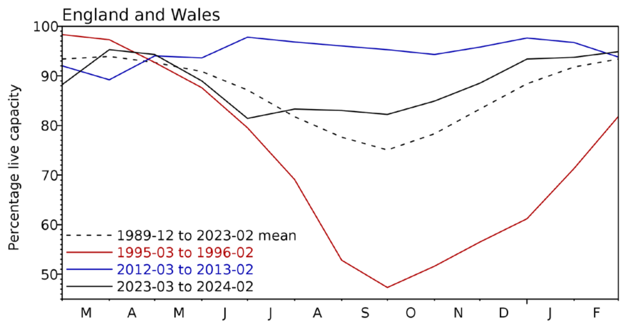
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. The rankings are designed as a qualitative indicator, and ranks at extreme levels, and when levels are changing rapidly, need to be interpreted with caution.

Reservoirs . . . Reservoirs . . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



Percentage live capacity of selected reservoirs at end of month

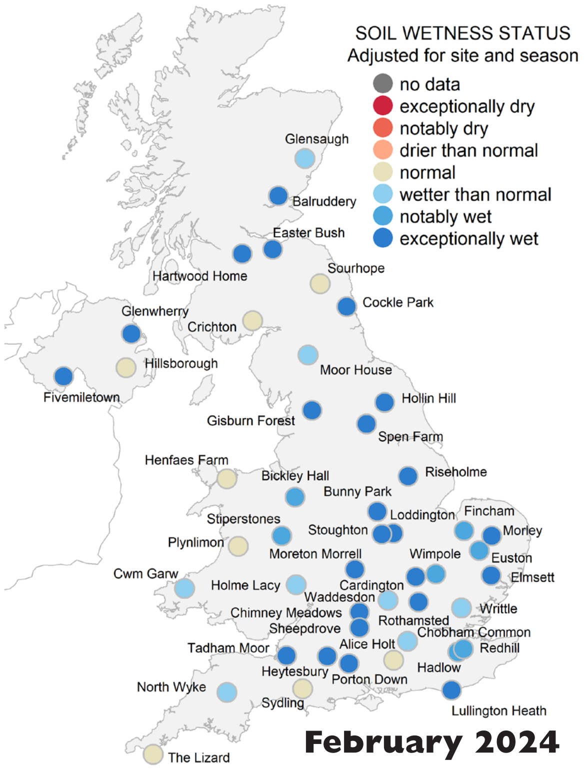
Area	Reservoir		Capacity (Ml)	2023 Dec	2024 Jan	2024 Feb	Feb Anom.	Min Feb	Year* of min	2023 Feb	Diff 24-23
North West	N Command Zone	•	124929	100	99	100	7	78	1996	88	12
	Vyrnwy		55146	100	100	100	5	59	1996	86	14
Northumbrian	Teesdale	•	87936	100	100	99	7	72	1996	87	12
	Kielder		(199175)	99	98	95	2	81	1993	90	5
Severn-Trent	Clywedog		49936	100	92	95	3	77	1996	89	5
	Derwent Valley	•	46692	100	96	100	4	46	1996	89	10
Yorkshire	Washburn	•	23373	89	94	98	5	53	1996	95	3
	Bradford Supply	•	40942	100	100	100	5	53	1996	83	16
Anglian	Grafham		(55490)	82	77	77	-10	72	1997	80	-2
	Rutland		(116580)	92	90	90	0	71	2012	96	-7
Thames	London	•	202828	89	92	95	2	83	1988	93	2
	Farmoor	•	13822	85	92	84	-9	64	1991	99	-15
Southern	Bewl		31000	66	66	86	-1	40	2012	96	-10
	Ardingly		4685	100	100	100	3	46	2012	100	0
Wessex	Clatworthy		5662	100	100	100	2	82	1992	92	8
	Bristol	•	(38666)	100	99	99	7	65	1992	96	3
South West	Colliford		28540	73	78	89	4	49	2023	49	40
	Roadford		34500	82	89	100	15	35	1996	58	42
	Wimbleball		21320	100	100	100	5	72	1996	97	3
	Stithians		4967	100	100	100	6	45	1992	92	8
Welsh	Celyn & Brenig	•	131155	80	84	85	-12	69	1996	79	7
	Brianne		62140	100	100	100	2	89	2023	89	11
	Big Five	•	69762	98	99	100	4	85	1988	93	7
	Elan Valley	•	99106	100	100	100	2	88	1993	93	7
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	98	99	98	2	73	1999	98	0
	East Lothian	•	9317	100	100	100	1	91	1990	100	0
Scotland(W)	Loch Katrine	•	110326	99	100	100	5	76	2010	98	2
	Daer		22494	86	87	88	-10	88	2024	88	0
	Loch Thom		10721	100	99	100	1	90	2004	99	1
Northern Ireland	Total+	•	56800	100	100	99	7	81	2004	92	7
	Silent Valley	•	20634	100	100	100	10	57	2002	89	11

( ) figures in parentheses relate to gross storage • denotes reservoir groups *last occurrence

+ excludes Lough Neagh

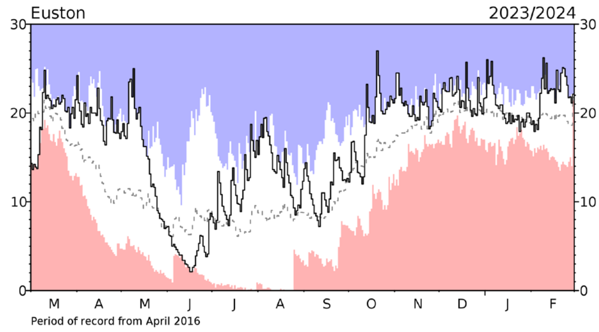
Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

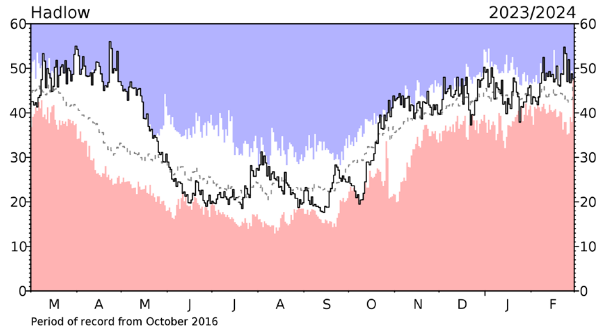
Soil Moisture . . . Soil Moisture

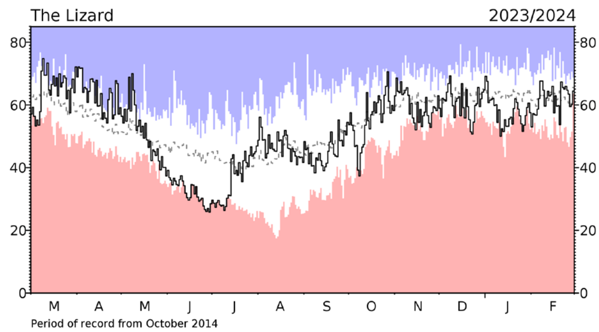


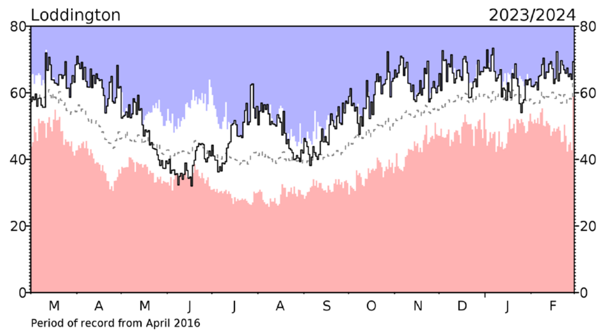
The persistent wet weather throughout the month means that soil moisture levels remain high at most COSMOS-UK sites. Some sites have been very wet throughout the month, compared to their historical variability, particularly in central and southern England e.g. Bunny Park, Euston, Hadlow, Loddington. Other sites, such as Sydling, The Lizard, are within their normal ranges for the time of year. Standing water is still affecting some sites, particularly Tadham Moor, hence soil wetness reported can be well above saturation values.

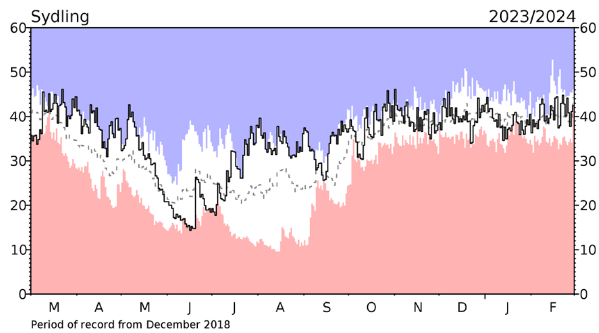
Overall, soil moisture remains high for much of the COSMOS-UK network, following a persistently wet February and an overall wet and mild winter.











Soil moisture data

These data are from UKCEH's COSMOS-UK network. The time series graphs show volumetric water content as a percentage in black together with the maximum and minimum daily values for the period-of-record of the sites. The dashed line represents the period-of-record mean VWC. For more information visit cosmos.ceh.ac.uk.

NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the UK Centre for Ecology & Hydrology (UKCEH) and the British Geological Survey (BGS). The NHMP aims to provide an authoritative voice on hydrological conditions throughout the UK, to place them in a historical context and, over time, identify and interpret any emerging hydrological trends. Hydrological analysis and interpretation within the Programme is based on the data holdings of the National River Flow Archive (NRFA; maintained by UKCEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

The Hydrological Summary is supported by the Natural Environment Research Council award number NE/R016429/1 as part of the UK-SCAPE programme delivering National Capability.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. A location map of all sites used in the Hydrological Summary can be found on the NHMP website. River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru (NRW), the Scottish Environment Protection Agency (SEPA) and, for Northern Ireland, the Department for Infrastructure - Rivers and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (high flow and low flow data in particular may be subject to significant revision).

Details of reservoir stocks are provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The Hydrological Summary and other NHMP outputs may also refer to and/or map soil moisture data for the UK. These data are provided by the Meteorological Office Rainfall and Evaporation Calculation System (MORECS). MORECS provides estimates of monthly soil moisture deficit in the form of averages over 40 x 40 km grid squares over Great Britain and Northern Ireland. The monthly time series of data extends back to 1961.

Rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA, NRW and SEPA. The areal rainfall figures have been produced by the Met Office National Climate Information Centre (NCIC), and are based on the HadUK-Grid 1km resolution gridded data from rain gauges. The majority of the full rain gauge network across the UK is operated by the EA, NRW, SEPA and Northern Ireland Water; supplementary rain gauges are operated by the Met Office. The Met Office NCIC monthly rainfall series extend back to 1836 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Hollis, 2019 available at https://doi.org/10.1002/gdj3.78

Long-term averages are based on the period 1991-2020 and are derived from the monthly areal series.

The regional figures for the current month in the hydrological summaries are based on a limited rain gauge network so these (and the associated return periods) should be regarded as a guide only.

For further details on rainfall or MORECS data, please contact the Met Office:

Tel: 0370 900 0100
Email: enquiries@metoffice.gov.uk

Enquiries

Enquiries should be directed to the NHMP:

Tel: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:

http://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk