Hydrological Summary
for the United Kingdom

May 2018

General
May felt like an early start to the summer, with prolonged periods of warm, dry weather which culminated in thunderstorms at month-end. Large parts of the UK registered monthly mean temperatures more than 1.5°C above average, and a maximum temperature of 28.7°C was recorded at Northolt (Greater London) on the Early May bank holiday. For the UK as whole, May rainfall was around three quarters of average with large areas of northern Britain registering less than half of average. In central and southern England, rainfall was above average and dominated by rainfall from thunderstorms in the last week. With the continued dry weather and above average soil moisture deficits (SMDs) in northern Britain, river flows were generally in the normal range or below, whilst in southern Britain river flows were in the normal range and often above normal in the south-east. Due to the delayed end to the recharge season, groundwater levels were in the normal range or above for the time of year. Reservoir stocks fell in the majority of index impoundments, substantially so at some in the north and west, although most remained only moderately below average for the end of May (Northern Command Zone and Daer were more than 10% below). Given the above average spring rainfall, groundwater levels and reservoir stocks, the water resources outlook remains healthy for the summer in the south and east, a significant transformation from the situation at the start of 2018. Conversely, a continuation of dry weather in the north and west would accentuate current rainfall deficiencies and increase the potential for low flows and localised water resource pressure in the summer.

Rainfall
The start of May was unsettled with westerly airflows bringing frontal rainfall, whilst warm and dry conditions prevailed for the rest of the month under predominantly anticyclonic weather patterns. In the last week, precipitation was dominated by localised thundery downpours in the Midlands and south-east England. On the 27th, 81mm of rainfall was recorded at Winterbourne (Birmingham) - 56mm of which fell in one hour - causing flash flooding (around 80 properties were flooded in the city), disruption and damage to road networks and power cuts to 1,000 homes in the West Midlands. South-east England bore the brunt of the impacts of further thunderstorms on the 29th (roads were flooded in Kent and flights were delayed at Stansted and Gatwick airports) and 31st with 38mm recorded at Brize Norton (Oxfordshire), severe rail disruption on Great Western services in the Thames Valley and flooding at Didcot Parkway train station. For May overall rainfall was below average across Scotland, northern and south-west England and parts of Wales; five regions registered half of average or less. In contrast, the intense downpours yielded patches of more than 170% of average rainfall in parts of the West Midlands and south-east England. For the UK as a whole, spring (March-May) rainfall was near average, but there was a distinct spatial difference in rainfall anomalies. Spring rainfall was below average in north-west Britain (it was the tenth driest spring in the Highlands region) and above average in the south and east (it was the eighth wettest spring in the South West region).

River flows
Recessions dominated river flows in May and lasted through the month across much of Scotland and northern and south-west England. By month-end flows on the Spey, Scottish Dee, Forth, Nevis and South Tyne approached or went below their daily minima. Elsewhere, flows remained around or above average throughout May, with moderate flow responses to individual rainfall events. Following the wet end to April in south-east England, a new May daily flow maximum was set on the 1st on the Great Stour (in a record from 1965). On the 29th, 40 Flood Alerts and Warnings were issued in the Midlands, record levels were recorded on many rivers in Birmingham, although most property flooding was from surface water. May monthly mean flows were below average across northern and western Britain, with flows on the Annacloy, Naver, Lune, Eden, Ribble and English Tyne less than half the May average. In contrast, flows were above average in the Midlands, East Anglia and south-east England; flows were notably high on the Great Stour (due to rainfall early and late in the month) and on the Itchen (as a result of high groundwater levels). This spatial contrast was mirrored and exaggerated for spring (March-May) river flows. Several catchments in western Scotland and Northern Ireland recorded notably low flows (the Ewe registered around half of the spring average flow) and three catchments in the Welsh borders and south-west England registered new record spring average flows (the Teme, Tone and Kenwyn).

Groundwater
SMDs increased across the UK, substantially so in some areas and at month-end were above average in the north-west and below average in the south-east. Groundwater levels generally fell in the Chalk, following their usual seasonal recession, with the exception of some slower responding boreholes or where some late recharge occurred (in the Chilterns, East Anglia and North Downs). Despite falling, groundwater levels remained exceptionally high at Tilshead and notably high at Dalton Holme, Compton House and Chilgrove House. Elsewhere, levels were generally in the normal range or above, with the exception of Dial Farm where they remained below normal for the time of year. In the more rapidly responding Magnesian and Jurassic limestones levels fell and were in the normal range or above, except at Aycliffe where levels rose and were exceptionally high. In the Upper Greensand, levels at Lime Kiln Way rose slightly but remained in the normal range. In the Fell Sandstone and throughout the north-western and south-western Permo-Triassic sandstones, levels fell but remained above normal (exceptionally so at Royalty Observatory) reflecting the slow response to above average rainfall for winter and spring in these areas. In the Permo-Triassic sandstone in the Midlands and Wales, levels remained in the normal range, receding at Llanfair DC, remaining stable at Heathlanes and rising at Nuttalls Farm. Levels in the rapidly responding Carboniferous Limestone fell during May, but remained in the normal range or above for the time of year.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

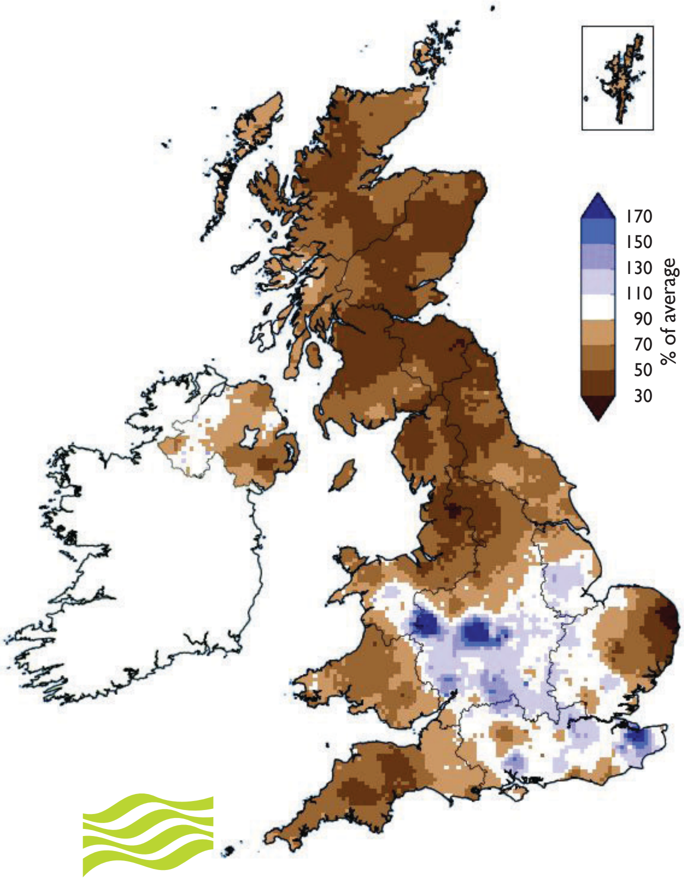
Region	Rainfall	May 2018	Mar18 – May18	RP	Dec17– May18	RP	Sep17 – May18	RP	Jun17 – May18	RP
United	mm	**49**	239		559		887		1202	
Kingdom	%	**72**	104	2-5	100	2-5	99	2-5	106	5-10
England	mm	**46**	230		463		676		922	
	%	**80**	129	8-12	114	5-10	104	2-5	109	2-5
Scotland	mm	**46**	232		654		1140		1551	
	%	**58**	77	2-5	85	2-5	93	2-5	102	5-10
Wales	mm	**64**	336		776		1203		1568	
	%	**77**	119	5-10	110	2-5	105	2-5	110	5-10
Northern	mm	**58**	225		586		951		1301	
Ireland	%	**80**	92	2-5	105	2-5	108	8-12	114	20-30
England &	mm	**49**	244		506		749		1011	
Wales	%	**80**	127	8-12	113	5-10	104	2-5	109	2-5
North West	mm	**36**	204		556		1019		1387	
	%	**50**	85	2-5	94	2-5	106	2-5	113	5-10
Northumbria	mm	**28**	208		412		657		939	
	%	**50**	114	2-5	99	2-5	99	2-5	108	2-5
Severn-Trent	mm	**63**	248		455		636		847	
	%	**110**	145	15-25	122	5-10	107	2-5	108	2-5
Yorkshire	mm	**33**	232		429		668		946	
	%	**63**	130	5-10	105	2-5	104	2-5	112	2-5
Anglian	mm	**42**	188		363		485		686	
	%	**86**	135	8-12	127	8-12	105	2-5	110	2-5
Thames	mm	**61**	225		424		558		760	
	%	**109**	141	10-20	122	5-10	100	2-5	106	2-5
Southern	mm	**57**	240		483		631		856	
	%	**107**	146	15-25	124	5-10	98	2-5	107	2-5
Wessex	mm	**49**	260		509		709		931	
	%	**82**	140	10-20	116	2-5	100	2-5	105	2-5
South West	mm	**42**	322		709		1027		1335	
	%	**56**	130	10-15	113	2-5	103	2-5	109	2-5
Welsh	mm	**63**	330		752		1155		1506	
	%	**77**	121	5-10	111	2-5	105	2-5	110	5-10
Highland	mm	**52**	216		740		1364		1804	
	%	**59**	60	8-12	78	2-5	91	2-5	99	2-5
North East	mm	**33**	194		379		717		1030	
	%	**50**	93	2-5	79	8-12	91	2-5	101	2-5
Tay	mm	**40**	248		539		866		1216	
	%	**51**	91	2-5	79	2-5	80	5-10	91	2-5
Forth	mm	**31**	229		533		811		1181	
	%	**44**	95	2-5	89	2-5	85	2-5	98	2-5
Tweed	mm	**31**	238		502		765		1095	
	%	**47**	114	2-5	101	2-5	97	2-5	107	2-5
Solway	mm	**50**	253		700		1172		1655	
	%	**60**	85	2-5	95	2-5	99	2-5	111	10-20
Clyde	mm	**57**	273		838		1424		1922	
	%	**64**	77	2-5	92	2-5	97	2-5	105	5-10

% = percentage of 1981-2010 average *RP = Return period*

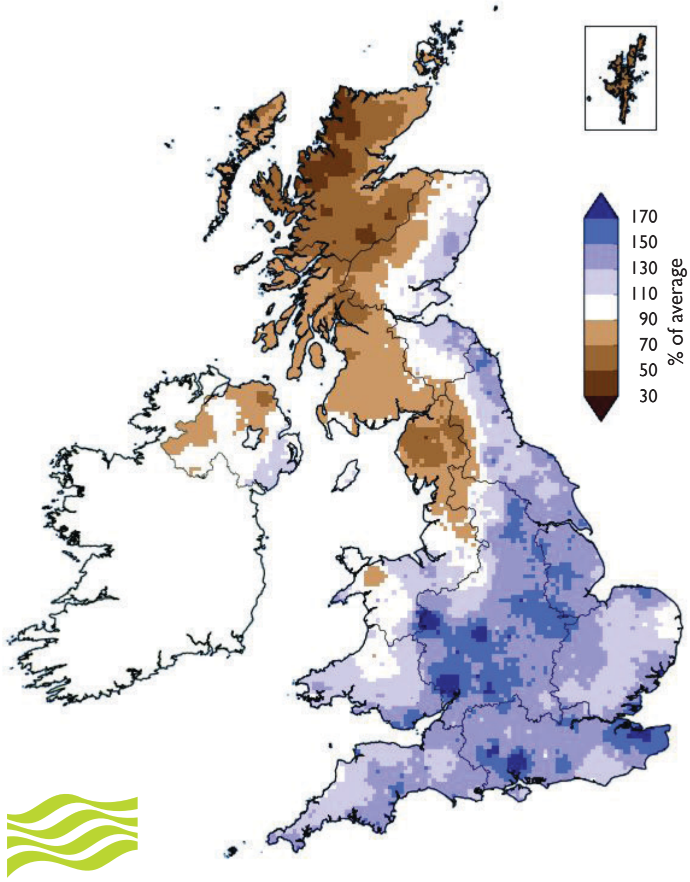
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; 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 2018 are provisional.

Rainfall . . . Rainfall . . .

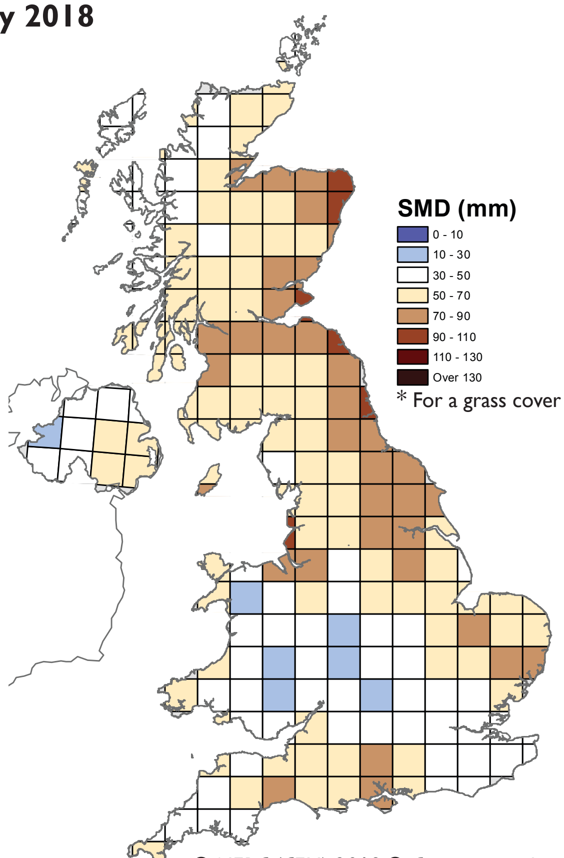
**May 2018 rainfall
as % of 1981-2010 average**



**March 2018 - May 2018 rainfall
as % of 1981-2010 average**



**MORECS Soil Moisture Deficits*
May 2018**



Hydrological Outlook UK

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.

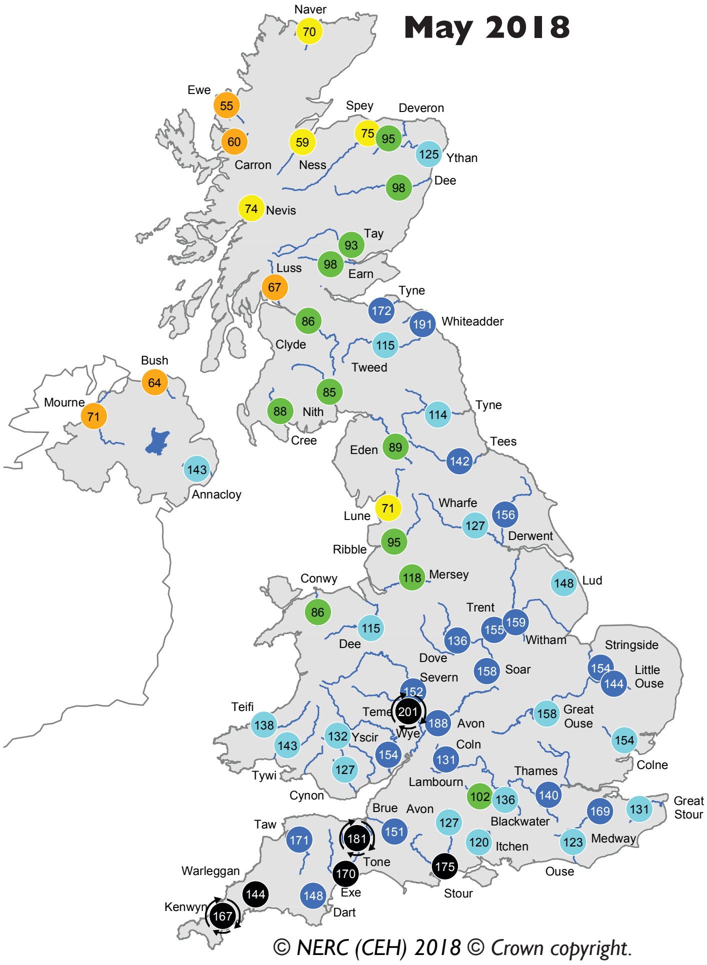
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from June 2018**
Issued: **08.06.2018**
using data to the end of May 2018

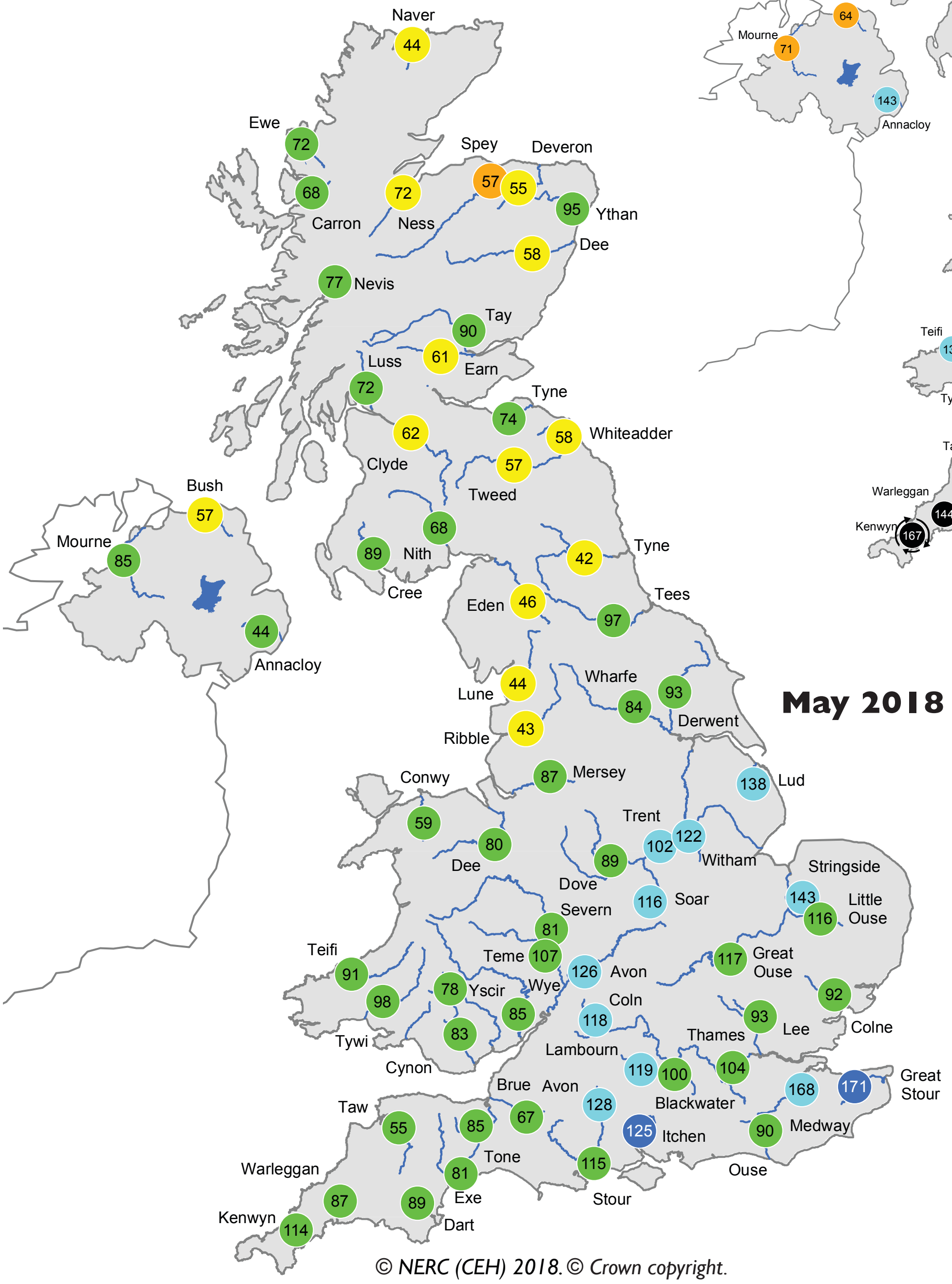
The outlook for June is for normal to below normal flows in the northern parts of Great Britain, and eastern Northern Ireland. River flows in the southern parts of Great Britain, and western Northern Ireland are likely to be normal to above normal for both June, and June-July-August. Groundwater levels across the UK are likely to be normal to above normal for the next three months.

River flow . . . River flow . . .

March 2018 - May 2018



May 2018



Key

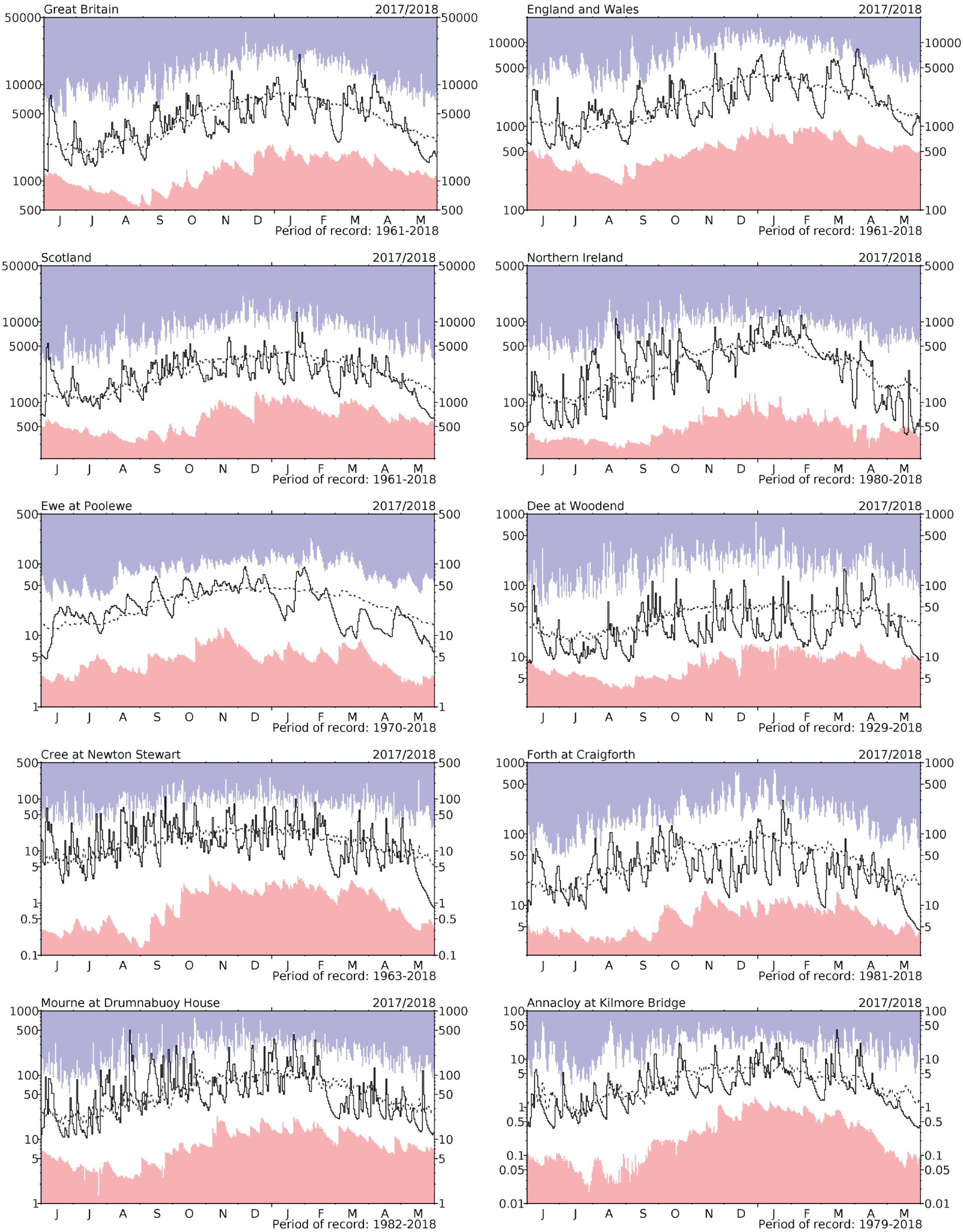
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*Based on 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. Note: the averaging period on which these percentages are based is 1981-2010. Percentages may be omitted where flows are under review.

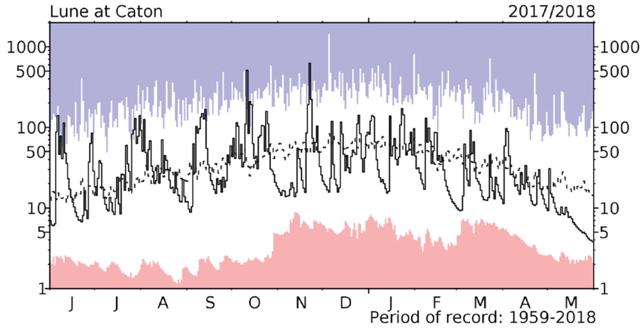
River flow . . . River flow . . .

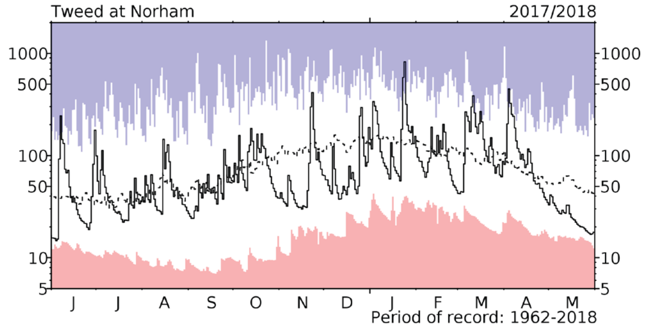


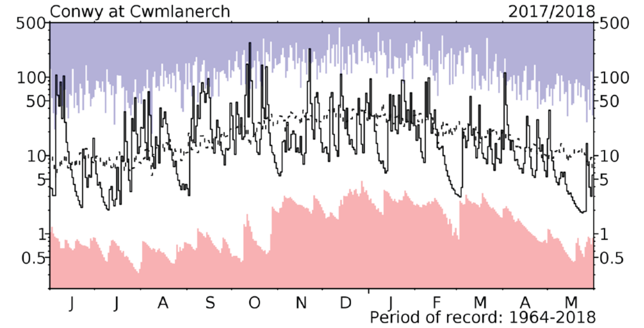
River flow hydrographs

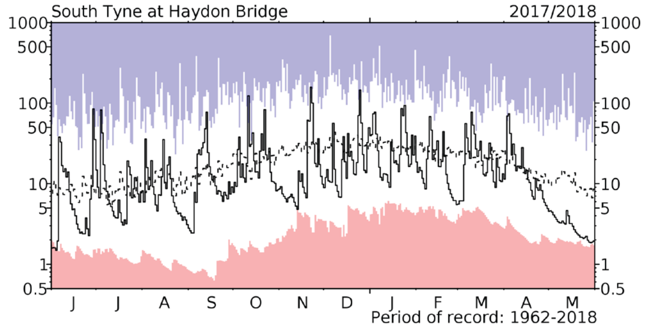
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to June 2017 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

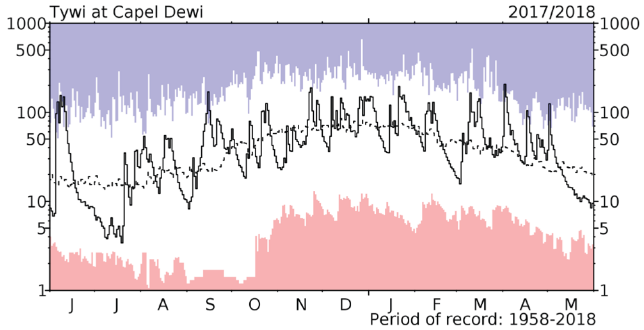
River flow . . . River flow . . .

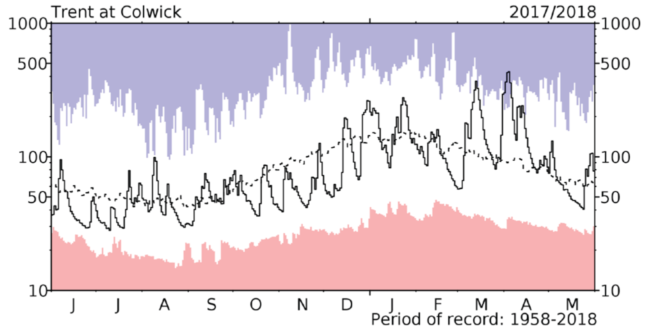


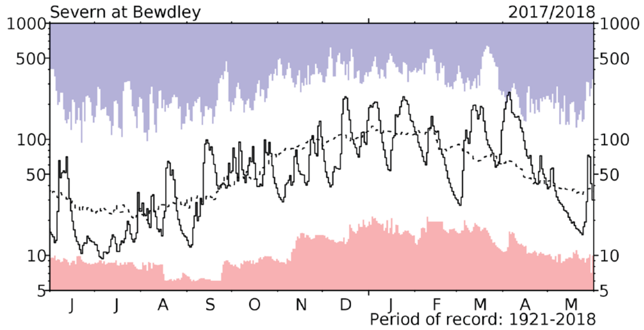


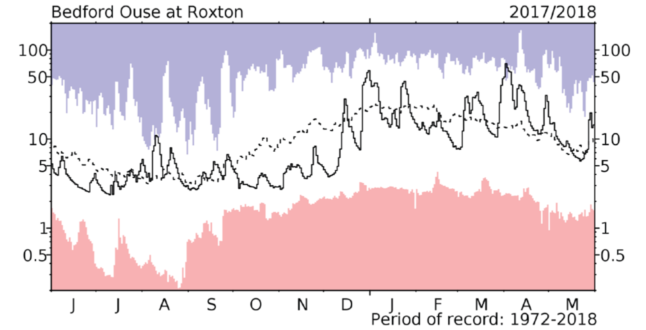


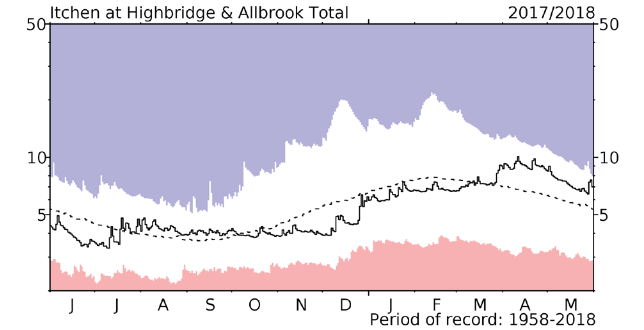


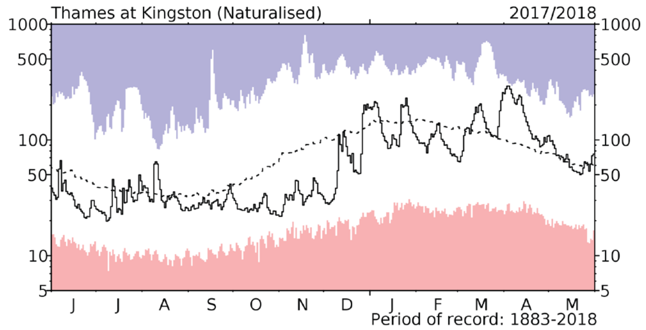


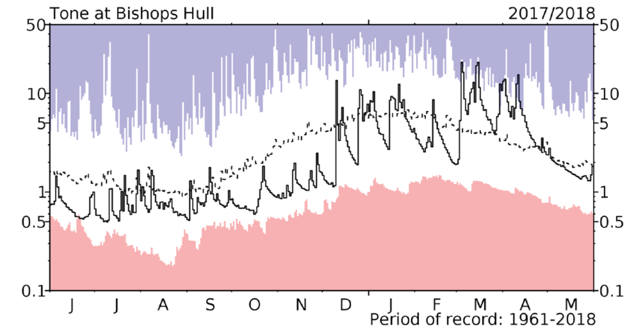


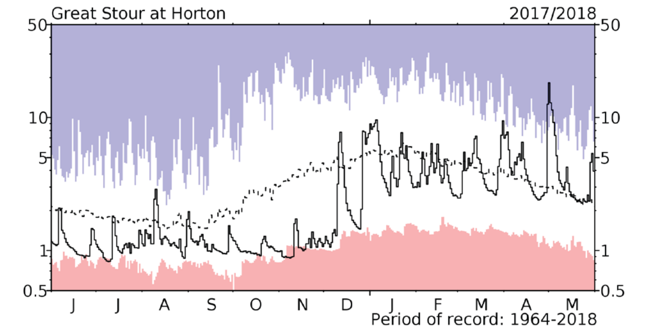




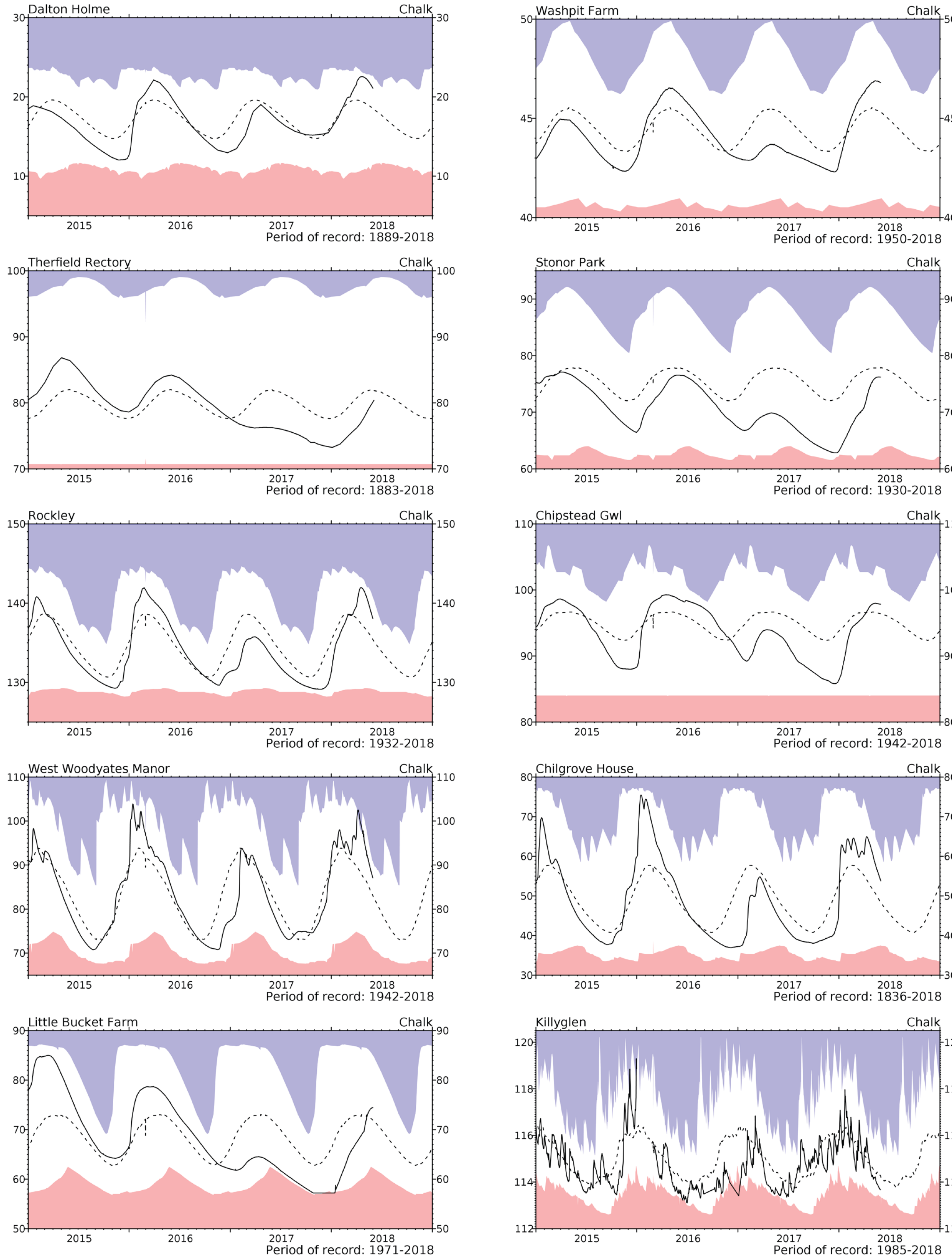




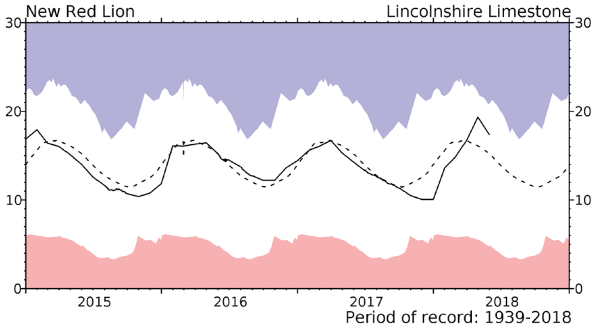


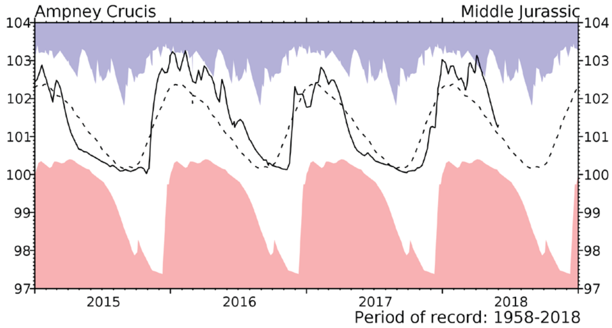


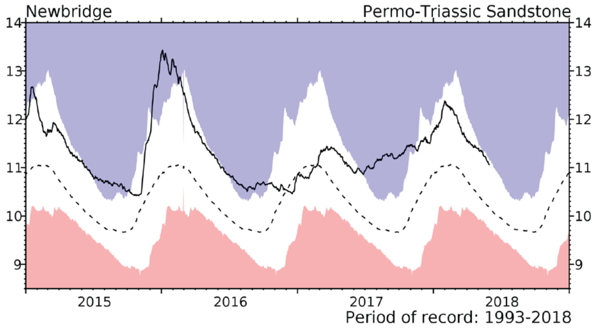
Groundwater . . . Groundwater

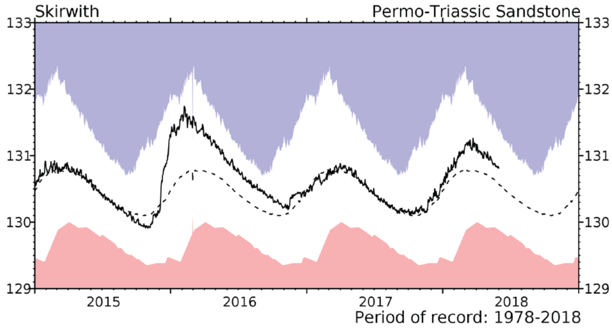


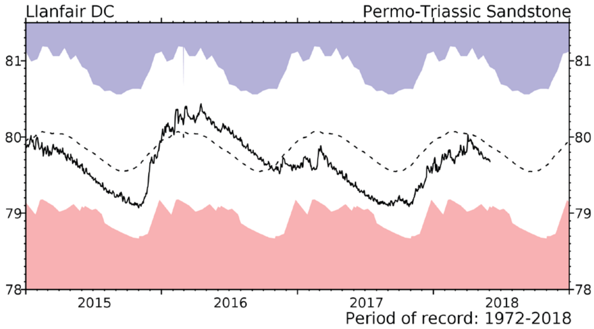
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is 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 displayed in a similar style to the river flow hydrographs. 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.

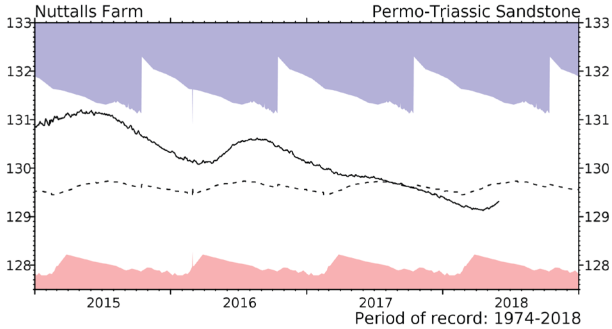

New Red Lion
Lincolnshire Limestone
2015 2016 2017 2018
Period of record: 1939-2018

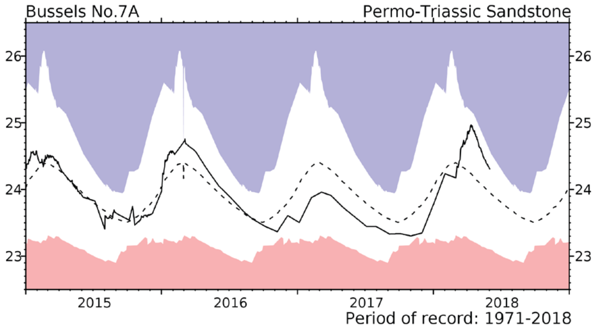

Ampney Crucis
Middle Jurassic
2015 2016 2017 2018
Period of record: 1958-2018

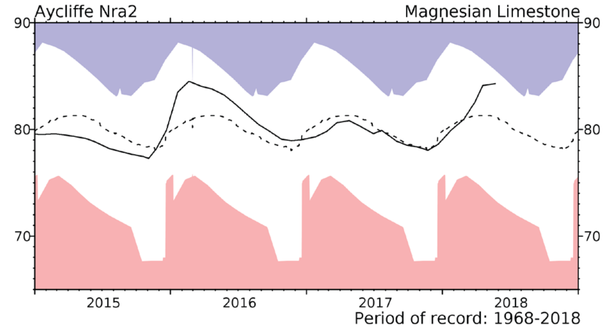

Newbridge
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1993-2018

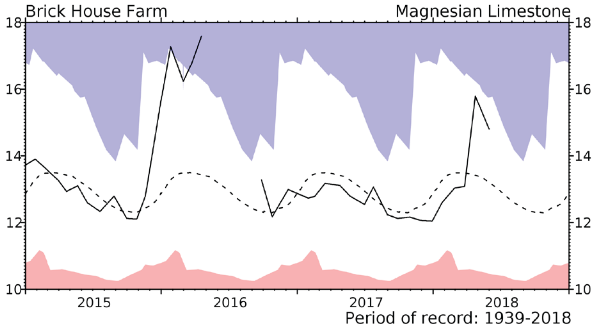

Skirwith
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1978-2018

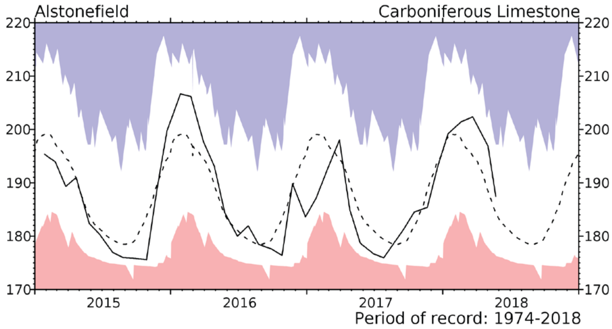

Llanfair DC
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1972-2018

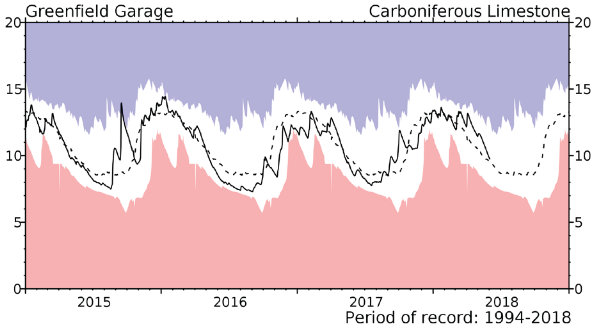

Nuttalls Farm
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1974-2018

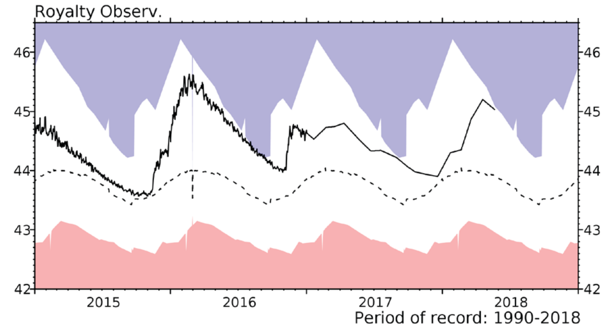

Bussels No.7A
Permo-Triassic Sandstone
2015 2016 2017 2018
Period of record: 1971-2018


Aycliffe Nra2
Magnesian Limestone
2015 2016 2017 2018
Period of record: 1968-2018

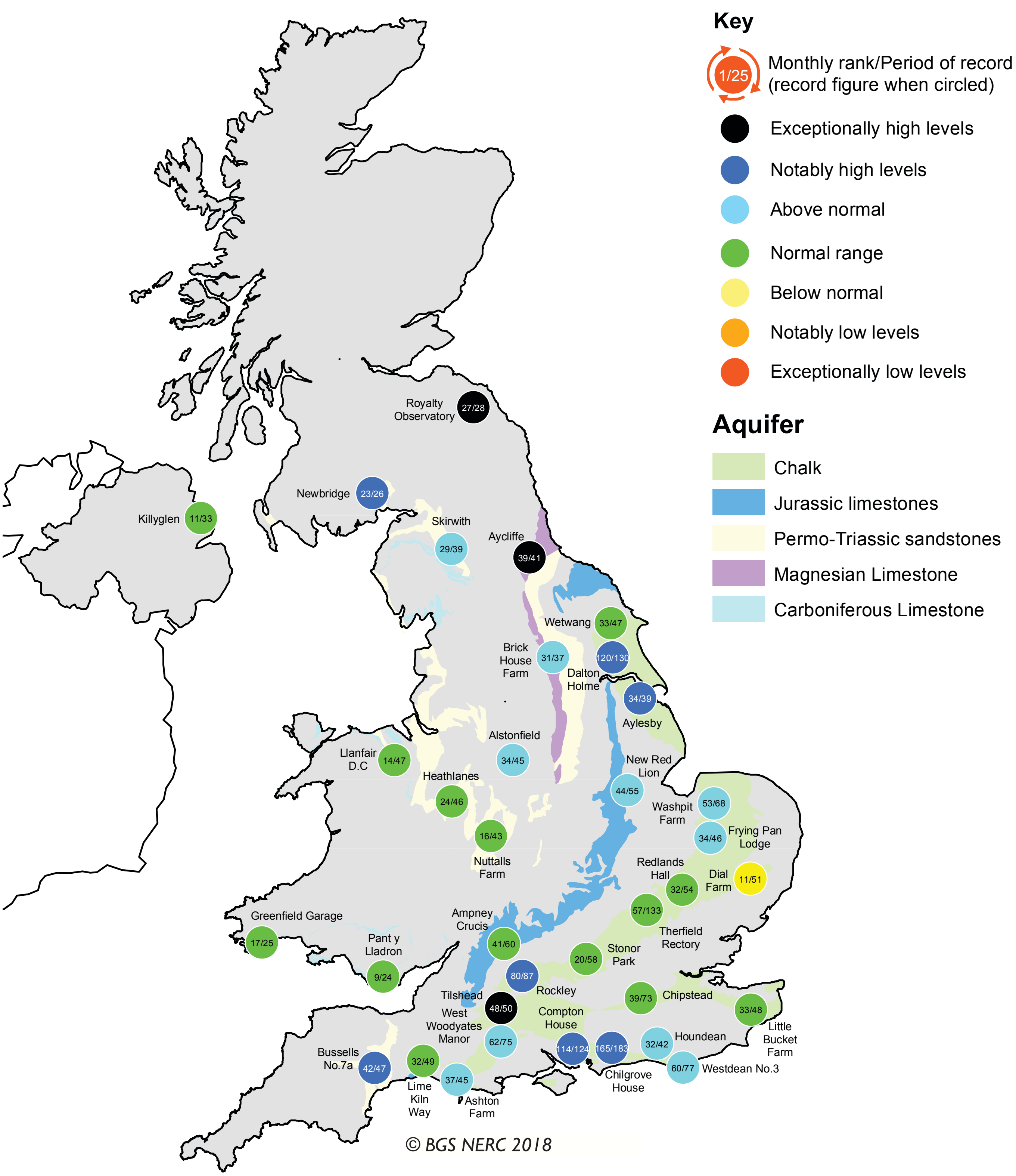

Brick House Farm
Magnesian Limestone
2015 2016 2017 2018
Period of record: 1939-2018


Alstonefield
Carboniferous Limestone
2015 2016 2017 2018
Period of record: 1974-2018


Greenfield Garage
Carboniferous Limestone
2015 2016 2017 2018
Period of record: 1994-2018


Royalty Observ.
2015 2016 2017 2018
Period of record: 1990-2018

Groundwater . . . Groundwater

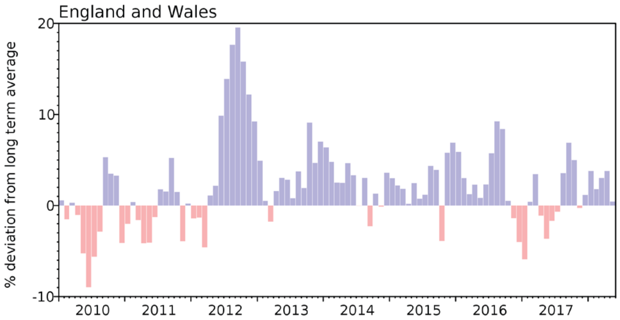


Groundwater levels - May 2018

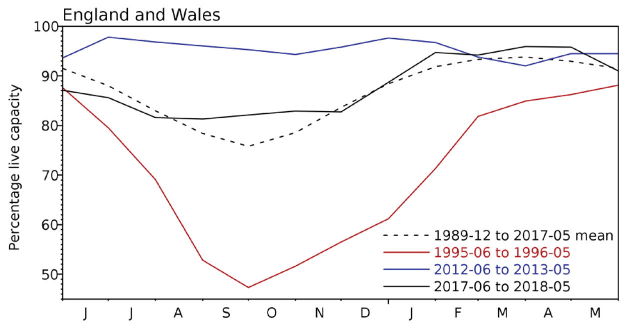
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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

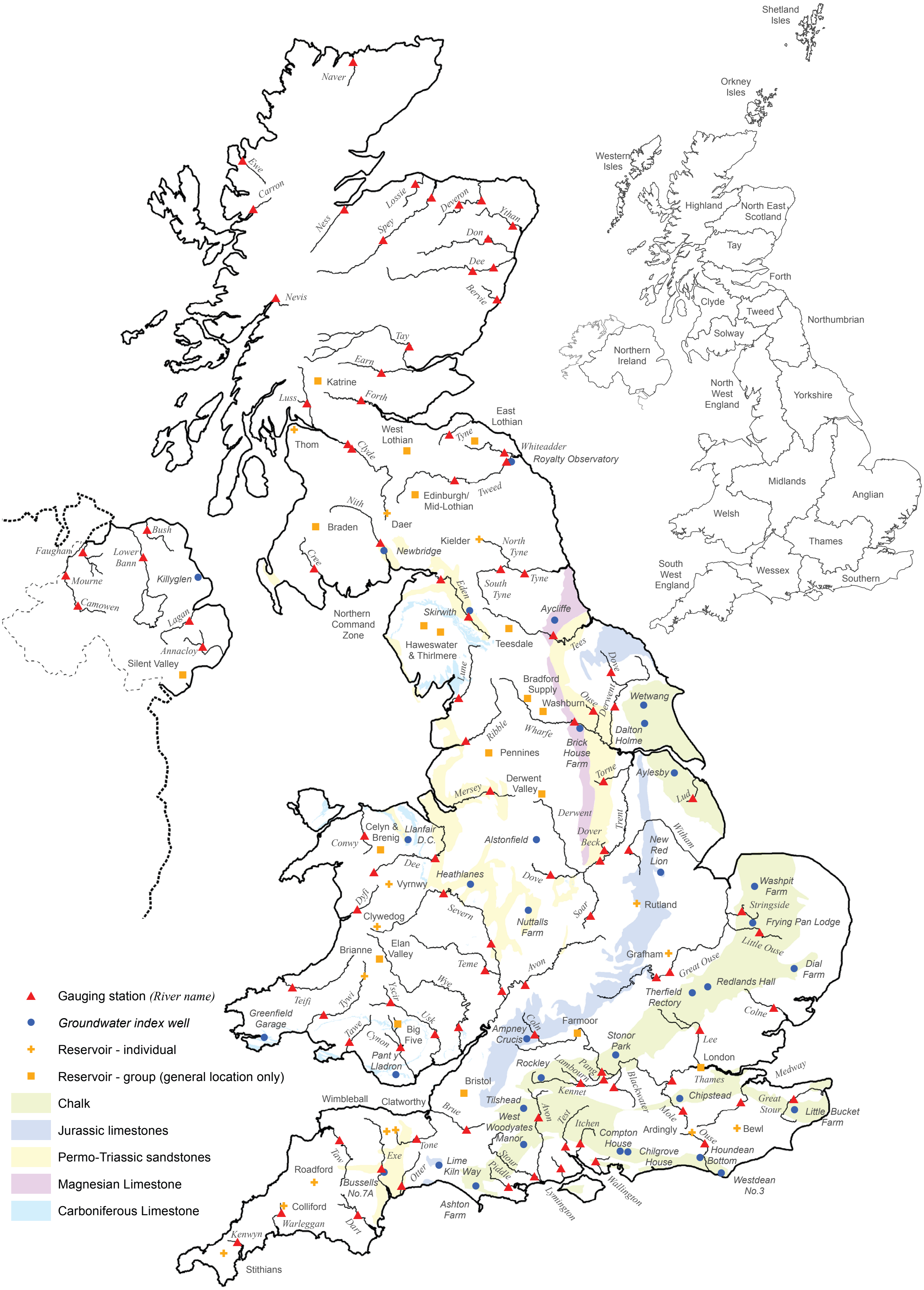
Area	Reservoir		Capacity (Ml)	2018 Mar	2018 Apr	2018 May	May Anom.	Min May	Year* of min	2017 May	Diff 18-17
North West	N Command Zone	•	124929	83	86	69	-12	50	1984	76	-7
	Vyrnwy		55146	100	100	93	4	69	1984	92	1
Northumbrian	Teesdale	•	87936	99	92	82	-4	64	1991	67	16
	Kielder		(199175)	91	93	91	-1	85	1989	87	4
Severn-Trent	Clywedog		49936	100	100	100	3	83	1989	98	2
	Derwent Valley	•	46692	100	98	86	-2	56	1996	76	10
Yorkshire	Washburn	•	23373	99	95	85	-2	72	1990	84	1
	Bradford Supply	•	40942	99	96	84	-2	70	1996	73	11
Anglian	Grafham		(55490)	96	94	92	-2	72	1997	96	-4
	Rutland		(116580)	95	97	96	4	75	1997	97	-1
Thames	London	•	202828	96	98	97	3	83	1990	97	0
	Farmoor	•	13822	96	92	98	1	90	2002	97	2
Southern	Bewl		31000	100	99	98	10	57	1990	68	30
	Ardingly		4685	100	100	100	1	89	2012	99	1
Wessex	Clatworthy		5364	100	100	93	7	67	1990	84	9
	Bristol	•	(38666)	99	97	93	4	70	1990	88	5
South West	Colliford		28540	100	99	98	12	52	1997	81	17
	Roadford		34500	95	96	92	9	48	1996	72	20
	Wimbleball		21320	100	100	98	7	74	2011	82	16
	Stithians		4967	95	100	96	9	66	1990	90	6
Welsh	Celyn & Brenig	•	131155	100	100	96	-1	82	1996	92	4
	Brianne		62140	100	97	94	-2	84	2011	93	1
	Big Five	•	69762	96	95	88	-2	70	1990	86	2
	Elan Valley	•	99106	99	99	93	0	81	2011	89	4
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	99	98	93	2	52	1998	80	13
	East Lothian	•	9374	100	100	99	2	84	1990	93	6
Scotland(W)	Loch Katrine	•	110326	94	96	88	1	66	2001	75	13
	Daer		22412	91	92	79	-11	69	2017	69	10
	Loch Thom		10798	100	100	95	4	72	2017	72	23
Northern	Total+	•	56800	98	95	88	2	69	2008	81	6
Ireland	Silent Valley	•	20634	100	95	86	4	56	2000	78	8

( ) 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.

Location map... Location map



NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) 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 CEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.
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 5km 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 1910 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM (2005) available at
http://www.metoffice.gov.uk/climate/uk/about/methods

Long-term averages are based on the period 1981-2010 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: 0870 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

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