Hydrological Summary
for the United Kingdom

July 2018

General

July was a summery month notable for extended periods of hot, sunny and dry weather across the UK. It was the third hottest July in the Central England Temperature series (from 1659) and for the summer so far (June-July), it was the third driest and second hottest for England and Wales in series from 1910. For the UK, July soil moisture deficits (SMDs) were the third highest in a series from 1961. Dry soils led to continuing agricultural stress, and numerous new, and continuing, wild fires across the UK; the fire on Saddleworth Moor (Greater Manchester) was extinguished on the 18th after 24 days. Exceptionally low river flows were registered in western areas and in parts of Scotland, with new July minima established in some catchments. Elsewhere, July mean flows were generally low to notably low and many catchments recorded less than a third of the July average. Groundwater levels generally remained in the normal range. Some impoundments in north-west England and Wales were 20% (or more) below the July average, and overall stocks for England and Wales were the joint second lowest for late July in a series from 1990, approaching the July minimum from 1995. Water use restrictions were lifted in Northern Ireland on the 19th and planned restrictions for August in north-west England were cancelled. However, reservoir stocks remained substantially below average in northern and western areas and river flows in responsive catchments were notably to exceptionally low, causing continued environmental stress. The water resources outlook for the remainder of 2018 is dependent on the replenishment of surface water resources which will be determined by the timing and magnitude of autumn/winter rainfall.

Rainfall

July was dominated by anticyclonic conditions, a continuation of the hot and dry weather of June. Large parts of England received little to no rain in the first three weeks of July. A 48-day period of no rain days (i.e. days with >1mm of rainfall) ended on the 20th in Wallingford (Oxfordshire), equalling the record established here in spring 1997 (in a series from 1962). In northern and western areas, conditions were less settled from the second week when frontal systems started to advance (e.g. 50mm at Kinlochewe, Wester Ross, on the 10th), although dry conditions generally prevailed. Elsewhere, localised thunderstorms caused flash flooding in Liverpool on the 13th and in Wrexham on the 16th. July ended with thunderstorms and heavy rain across the UK on the 27th-29th. Lightning strikes on the 27th caused delays on the East Coast mainline and surface water flooding caused major disruption to transport networks in Northern Ireland on the 28th (e.g. 90mm at Aldergrove, County Antrim). Despite extended dry spells, July rainfall totals were not exceptionally low at the national scale as a result of month-end rainfall, with 73% of average. Many regions registered less than two-thirds of average rainfall with parts of central and southern England receiving less than 30% of average. In contrast, above average rainfall was registered in parts of northern Scotland, northern England and Lincolnshire with over 170% of average in eastern Northern Ireland. For the summer so far (June-July), rainfall deficits were more pronounced; the majority of England and Wales received less than half the average with less than 30% in large parts of southern England. All regions of southern England received around a third of average or less. It was the second driest June-July for Anglian, Thames and Wessex regions and the third driest for England and Wales, in records from 1910.

River flows

Protracted recessions established in June continued in most catchments throughout July and did not break until the widespread thunderstorms and rainfall on the 27th-29th. The prolonged dry weather was reflected in new daily flow minima established in many responsive catchments, in some cases for more than 20 consecutive days, e.g. the Spey, South Tyne, and Forth which in July recorded the lowest daily flow in a record from 1981. The spatial extent of persistent low flows was reflected in UK outflows which approached or eclipsed daily minima throughout July and were the second lowest for July in a series from 1981. July mean flows were less than half the average for numerous catchments with many ranking the second or third lowest after the notable drought years of 1976 and 1984. New July minimum flows were established on the Spey, Scottish Dee and Whiteadder in records from 1952, 1929 and 1969, respectively. Flows were less than a fifth of average on the Taw (the third lowest in a series from 1959), the Welsh Dee and the Teifi (both the second lowest in records exceeding 49 years). In the south and east flows were below average in more responsive catchments, with exceptionally low flows on the Colne. The picture was similar for June-July average flows, albeit with slightly more catchments in the south-east in the normal range. Elsewhere, flows were notably to exceptionally low with new minima established on the Spey, Lune and Yscir. Numerous catchments across northern and western areas recorded less than half the average, some ranking as the second or third lowest June-July flows on record (e.g. the Deveron, Conwy and Taw).

Groundwater

Although SMDs decreased slightly in northern and western regions as a result of month-end rainfall, they increased across the principal aquifers in south-east England and remained well above average across the UK. Groundwater levels in the Chalk receded during July and were generally in the normal range with the exception of Dial Farm, where levels continued to rise slowly, and Killyglen, where levels fell but then rose due to recharge at month-end. Boreholes in the eastern Chalk (Dalton Holme, Aylesby, Washpit Farm and Little Bucket Farm) remained above normal. In the more rapidly responding Jurassic and Magnesian limestones levels fell and were normal in the former, and normal to above normal in the latter. Levels in the Upper Greensand at Lime Kiln Way fell and remained in the normal range. In the Permo-Triassic sandstones, levels fell (except at Nuttalls Farm, where they rose). Levels were generally in the normal range, but remained notably high in south-west Scotland and rose to above average in north-west England. Levels in the rapidly responding Carboniferous Limestone fell to below normal, notably so at Pant y Lladron. Levels in the Fell Sandstone at Royalty Observatory fell and were above normal.

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.

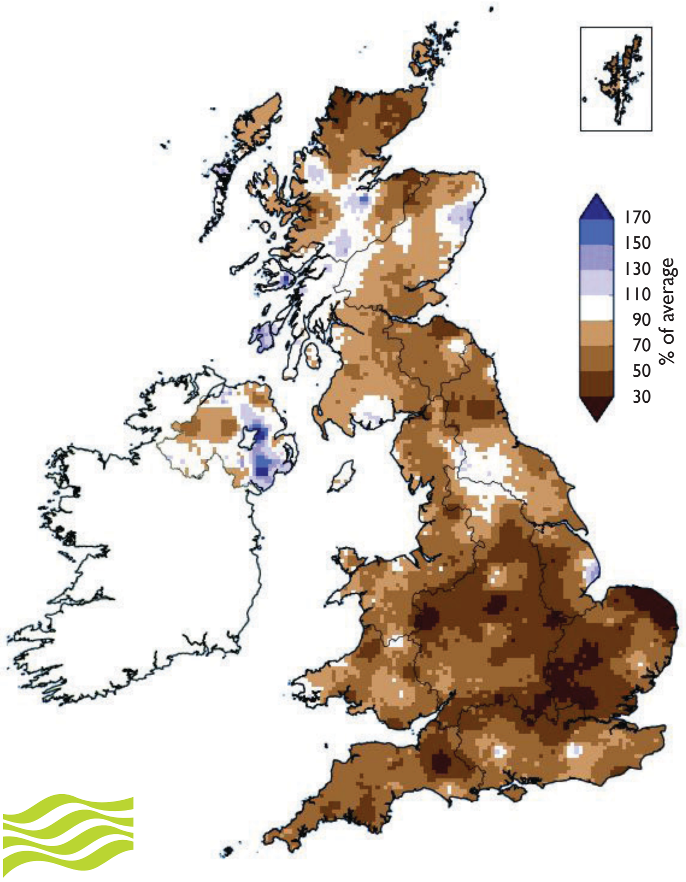
Region	Rainfall	Jul 2018	Jun18 – Jul18		May18 – Jul18		Feb18 – Jul18		Nov17 – Jul18	
				RP		*RP*		*RP*		*RP*
United Kingdom	mm	**55**	91		139		394		757	
	%	**73**	62	15-25	65	40-60	85	5-10	92	2-5
England	mm	**36**	51		97		325		581	
	%	**58**	41	30-50	54	50-80	90	2-5	94	2-5
Scotland	mm	**81**	153		199		475		970	
	%	**86**	86	2-5	78	10-15	78	5-10	88	2-5
Wales	mm	**63**	82		147		498		1004	
	%	**70**	48	15-25	57	30-50	88	2-5	97	2-5
Northern Ireland	mm	**81**	130		188		429		829	
	%	**99**	82	2-5	82	2-5	89	2-5	100	2-5
England & Wales	mm	**40**	55		104		349		640	
	%	**60**	43	30-50	55	50-80	90	2-5	95	2-5
North West	mm	**58**	97		133		372		795	
	%	**67**	58	10-20	56	60-90	75	15-25	90	2-5
Northumbria	mm	**45**	86		114		352		584	
	%	**67**	64	5-10	60	15-25	93	2-5	92	2-5
Severn-Trent	mm	**30**	43		106		326		553	
	%	**50**	35	40-60	59	15-25	94	2-5	97	2-5
Yorkshire	mm	**49**	70		103		348		567	
	%	**81**	54	10-15	57	30-50	94	2-5	92	2-5
Anglian	mm	**25**	33		76		259		439	
	%	**47**	31	60-90	48	40-60	91	2-5	97	2-5
Thames	mm	**23**	26		87		283		497	
	%	**45**	25	60-90	55	15-25	91	2-5	95	2-5
Southern	mm	**34**	37		93		322		565	
	%	**68**	37	40-60	61	10-15	101	2-5	97	2-5
Wessex	mm	**31**	34		84		334		611	
	%	**53**	30	25-40	48	20-35	92	2-5	94	2-5
South West	mm	**44**	55		97		438		860	
	%	**55**	37	20-35	43	50-80	88	2-5	94	2-5
Welsh	mm	**61**	80		143		486		970	
	%	**70**	48	15-25	57	30-50	89	2-5	97	2-5
Highland	mm	**85**	159		210		483		1140	
	%	**84**	83	5-10	75	10-20	67	10-20	86	2-5
North East	mm	**64**	105		137		347		609	
	%	**88**	73	5-10	66	20-30	81	5-10	83	8-12
Tay	mm	**74**	144		183		453		772	
	%	**90**	90	2-5	77	5-10	84	2-5	79	10-15
Forth	mm	**58**	135		166		421		737	
	%	**71**	85	2-5	73	5-10	85	2-5	84	2-5
Tweed	mm	**52**	126		157		429		706	
	%	**68**	85	2-5	73	5-10	99	2-5	95	2-5
Solway	mm	**79**	151		201		508		986	
	%	**81**	83	2-5	76	5-10	86	2-5	92	2-5
Clyde	mm	**111**	210		267		600		1217	
	%	**96**	99	2-5	89	2-5	84	2-5	93	2-5

% = 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.

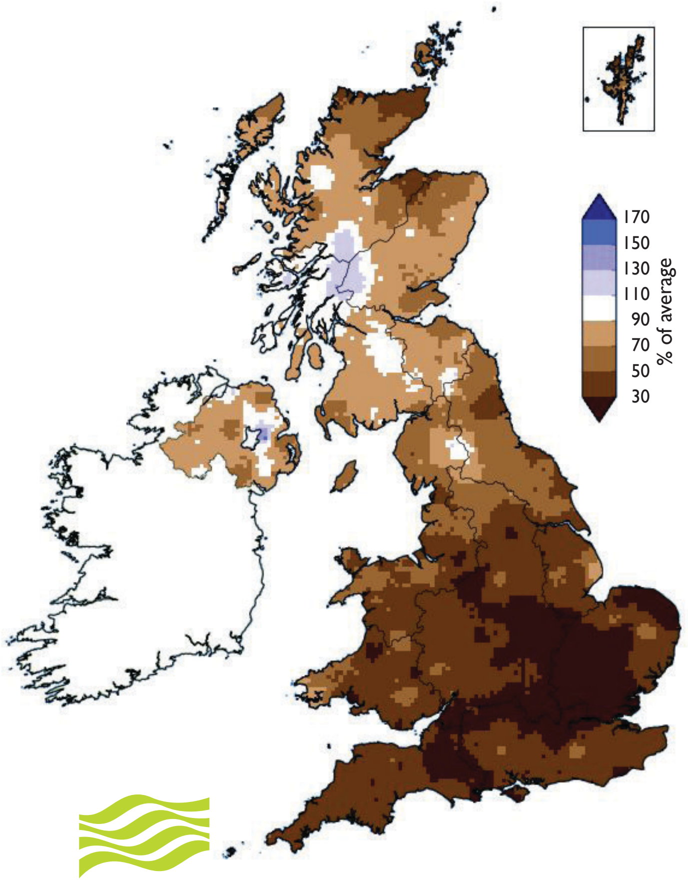
Rainfall . . . Rainfall . . .

July 2018 rainfall as % of 1981-2010 average



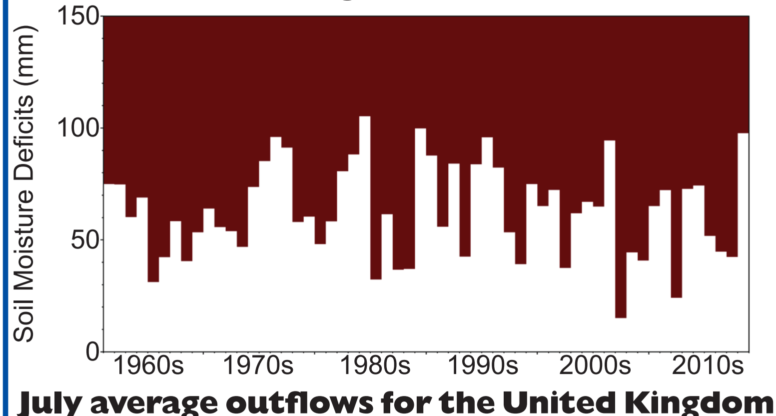
Met Office

June 2018 - July 2018 rainfall as % of 1981-2010 average

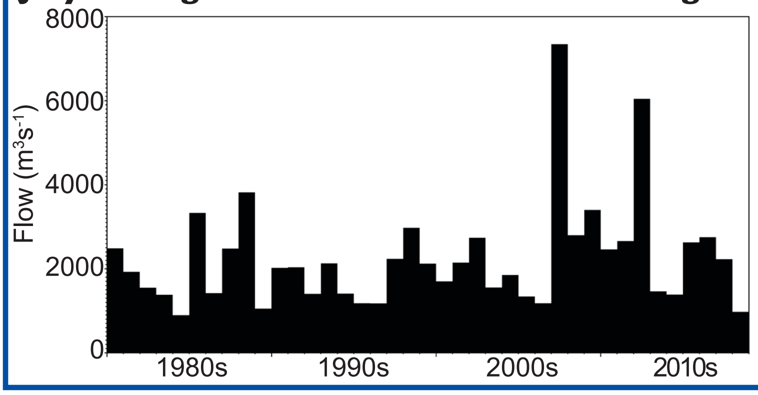


Met Office

End of July MORECS Soil Moisture Deficits for the United Kingdom



July average outflows for the United Kingdom



Hydrological Outlook UK

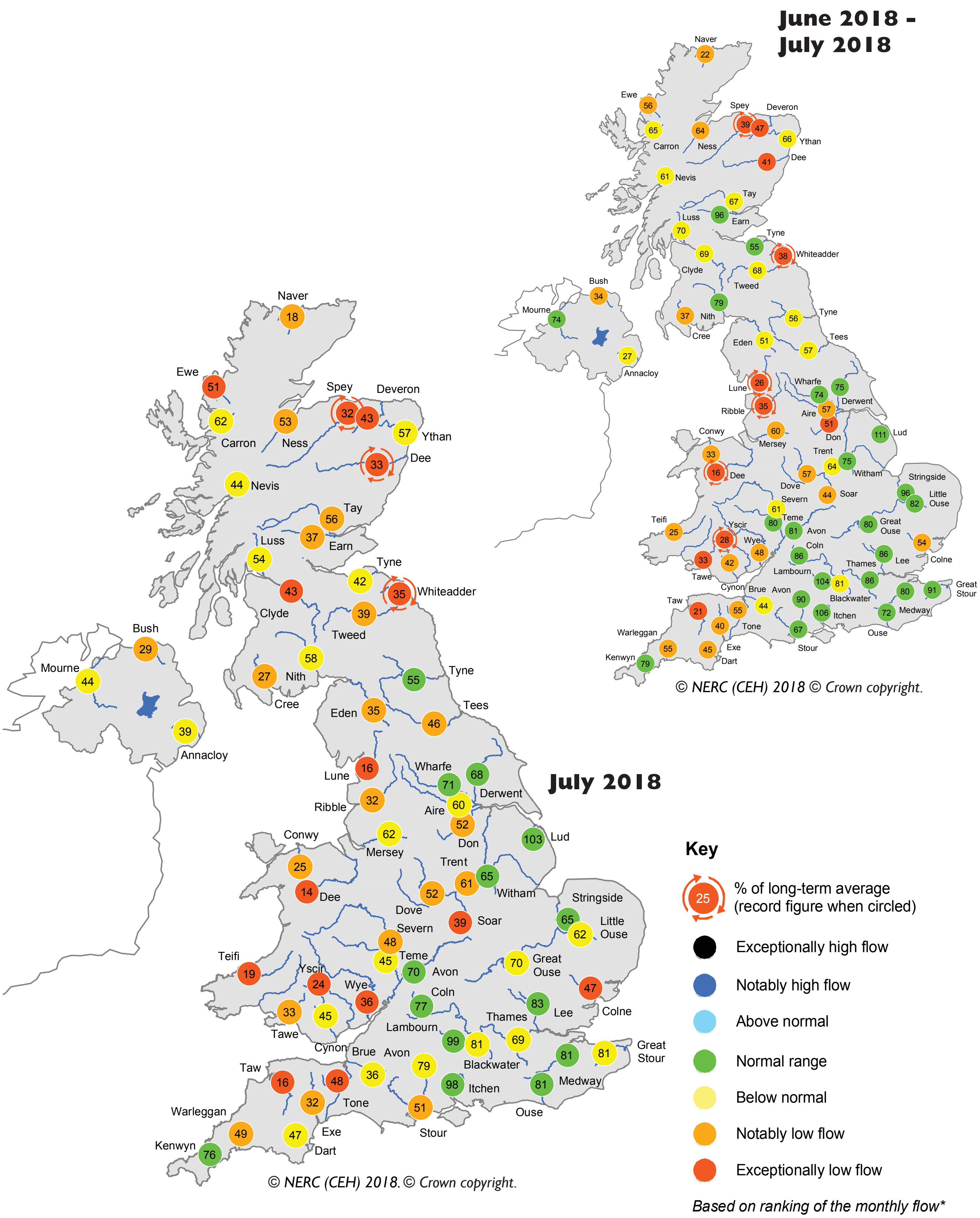
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from August 2018**
Issued: **08.08.2018**
using data to the end of July 2018

Flows in rivers to the north and west of the UK are likely to be below normal during August and in places may be notably low. In these regions river flows are likely to return towards normal over the three month period to October. In the south-east of the UK during August normal flows are most likely in rivers fed by groundwater, and in these rivers normal flows are likely to continue over the three month period to October. However, river flows in surface-fed river are likely to be below normal in August and for the coming three months. Across most of the UK, and for both August and the coming three months, groundwater levels are likely to be normal to above normal, although exceptions are possible.

River flow . . . River flow . . .



© NERC (CEH) 2018 © Crown copyright.

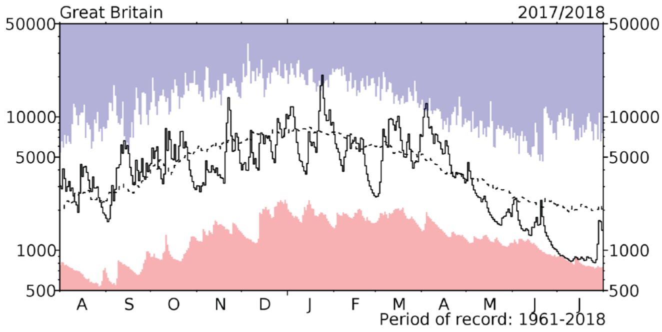
© NERC (CEH) 2018. © Crown copyright.

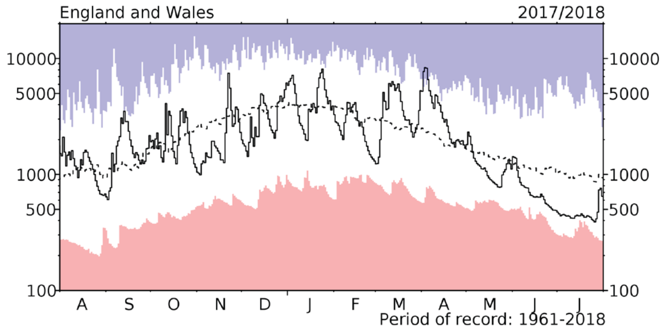
*Based on ranking of the monthly flow**

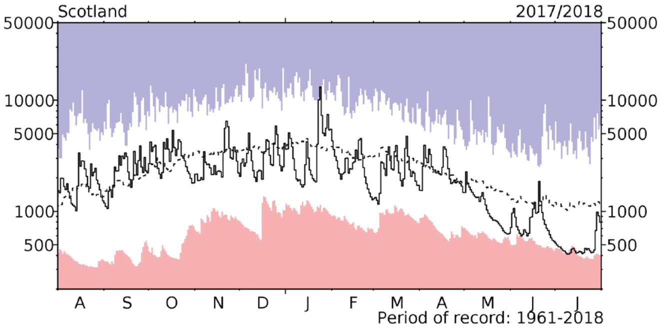
River flows

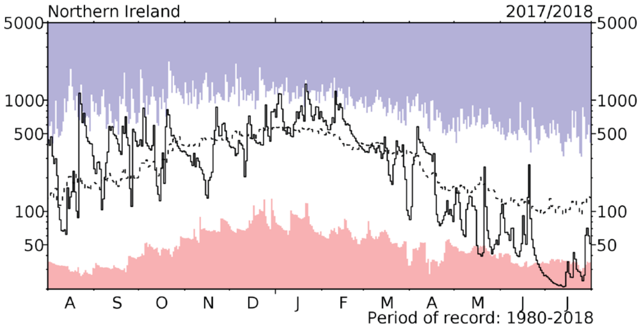
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the averaging period on which these percentages are based is 1981-2010. Percentages may be omitted where flows are under review.

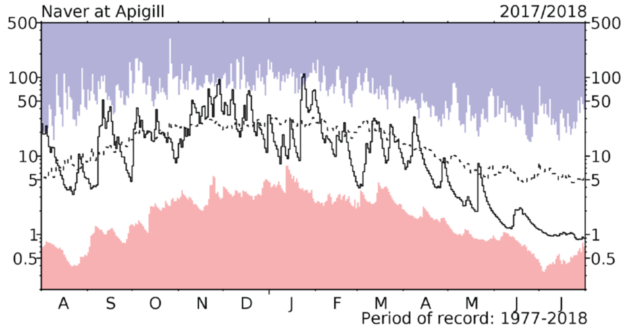
River flow ... River flow ...

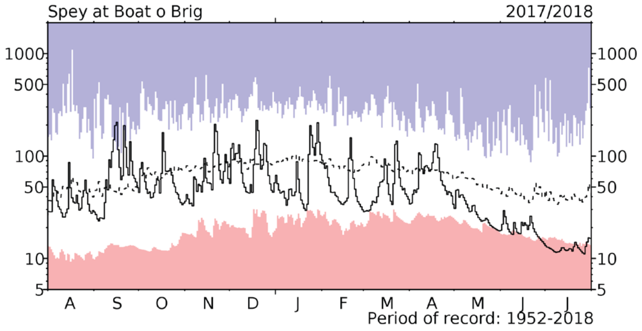


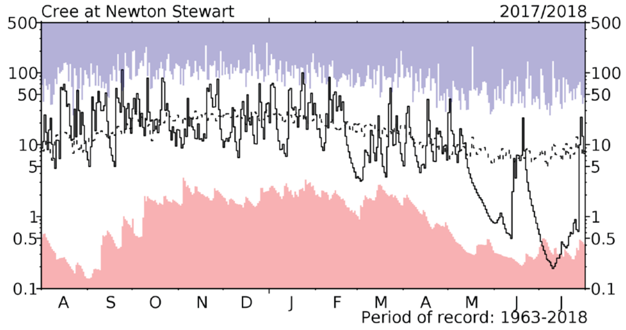


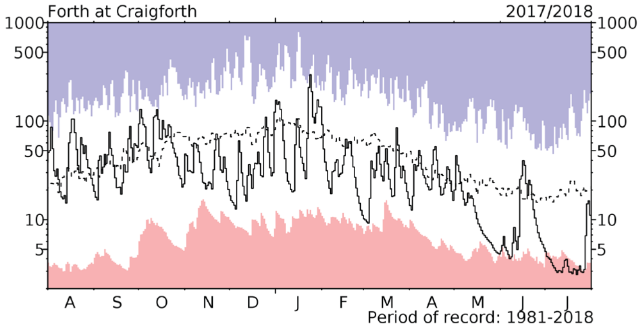


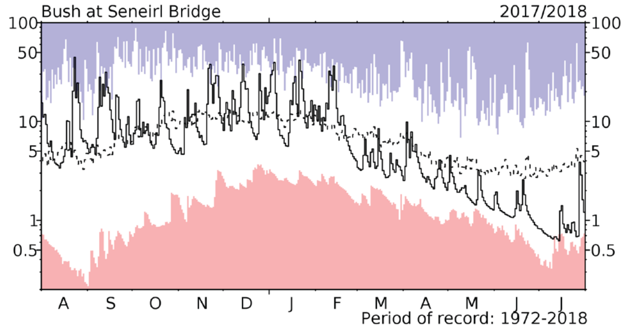


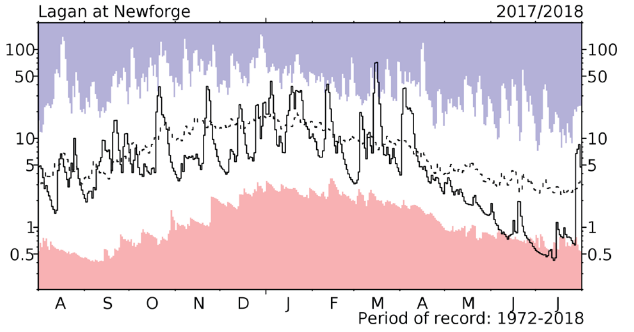








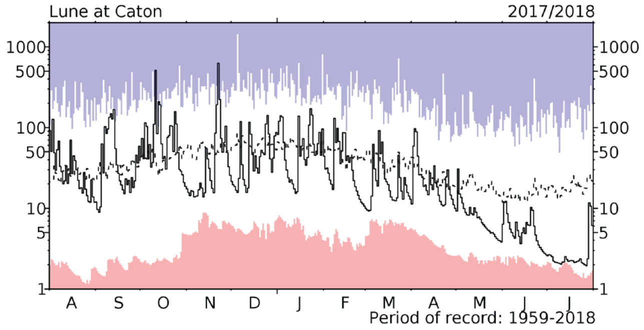




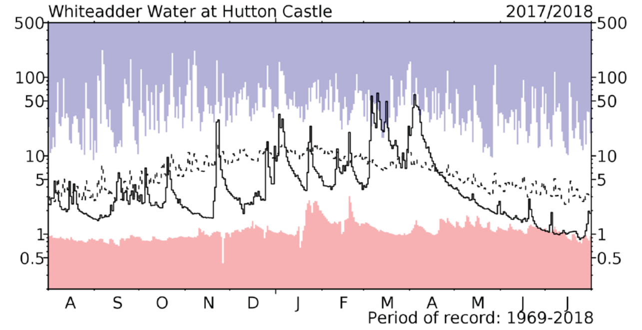
River flow hydrographs

*The river flow hydrographs show the daily mean flows (measured in m^{3}s^{-1}) together with the maximum and minimum daily flows prior to August 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.

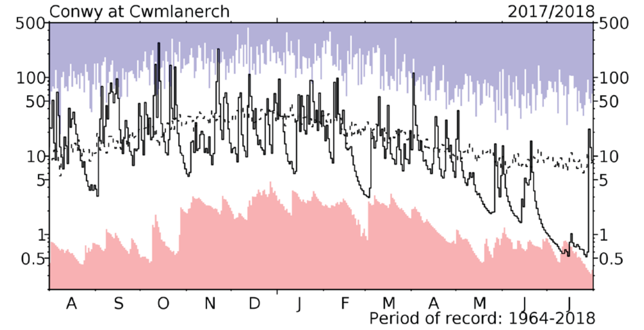
River flow . . . River flow . . .


Lune at Caton 2017/2018

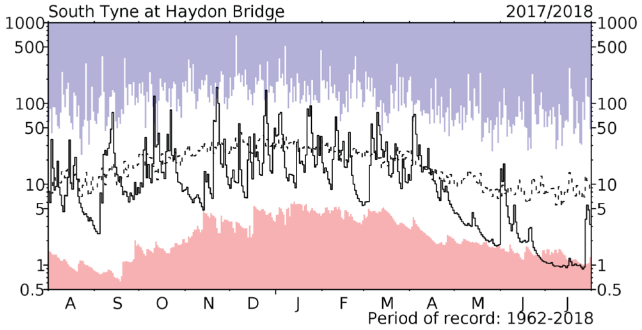
Period of record: 1959-2018


Whiteadder Water at Hutton Castle 2017/2018

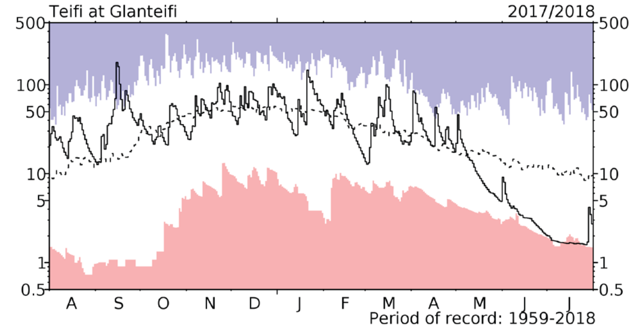
Period of record: 1969-2018


Conwy at Cwmlanerch 2017/2018

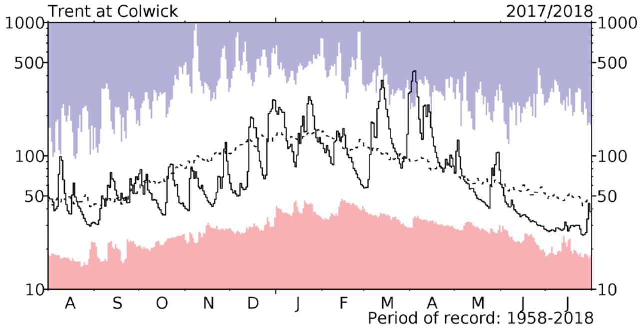
Period of record: 1964-2018


South Tyne at Haydon Bridge 2017/2018

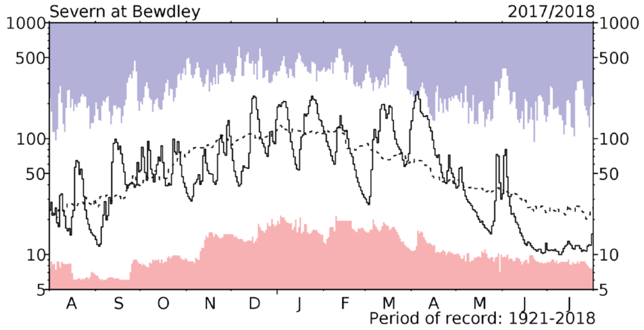
Period of record: 1962-2018


Teifi at Glanteifi 2017/2018

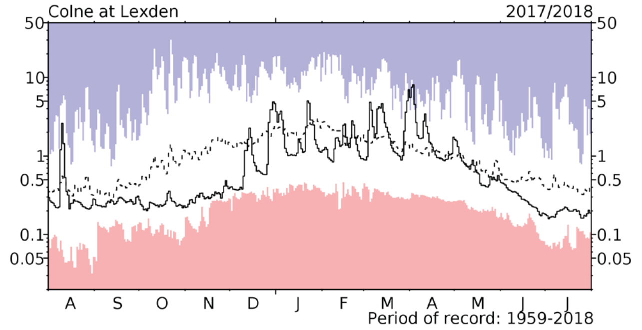
Period of record: 1959-2018


Trent at Colwick 2017/2018

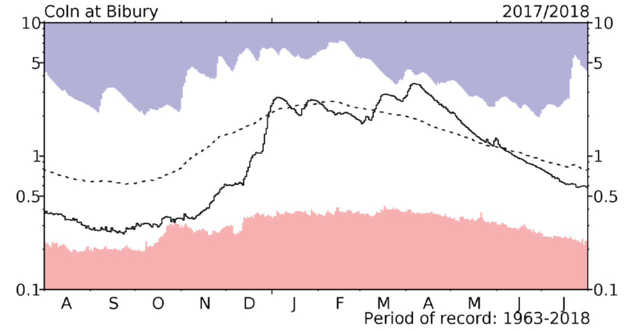
Period of record: 1958-2018


Severn at Bewdley 2017/2018

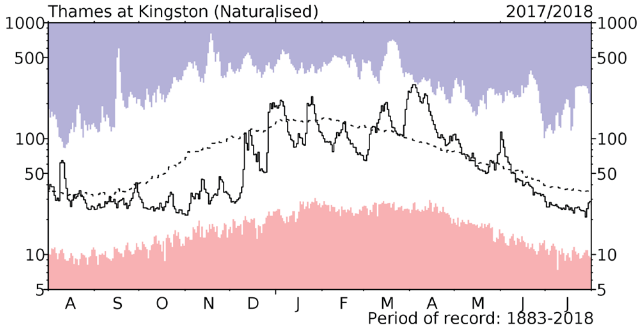
Period of record: 1921-2018


Colne at Lexden 2017/2018

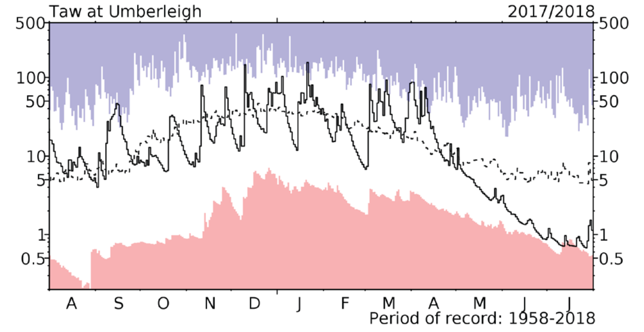
Period of record: 1959-2018


Coln at Bibury 2017/2018

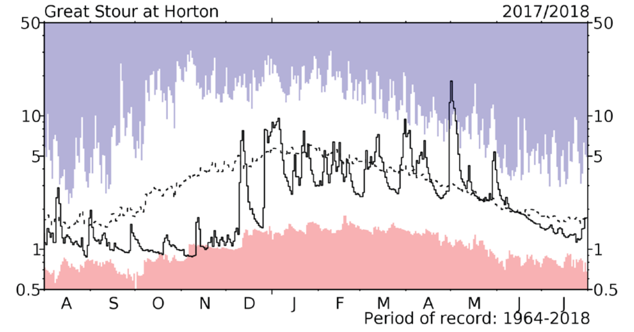
Period of record: 1963-2018


Thames at Kingston (Naturalised) 2017/2018

Period of record: 1883-2018

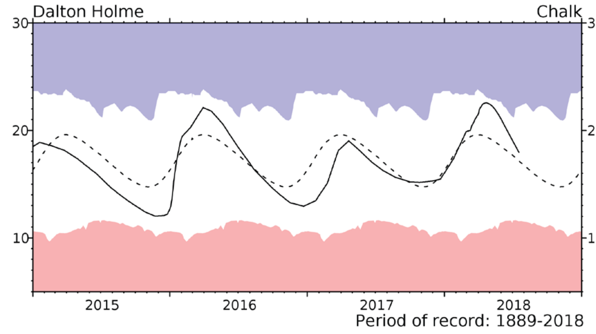

Taw at Umberleigh 2017/2018

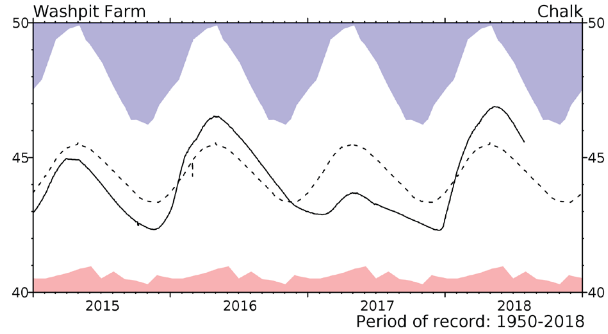
Period of record: 1958-2018

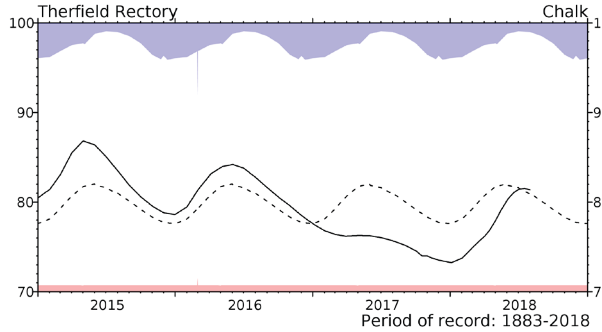

Great Stour at Horton 2017/2018

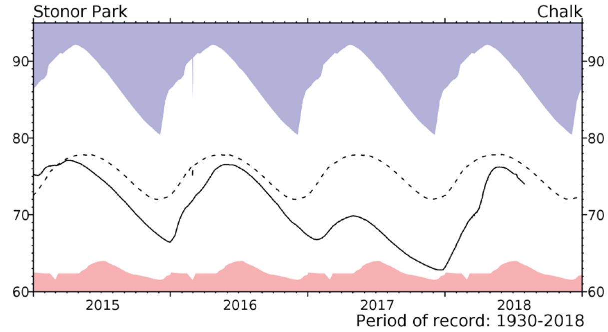
Period of record: 1964-2018

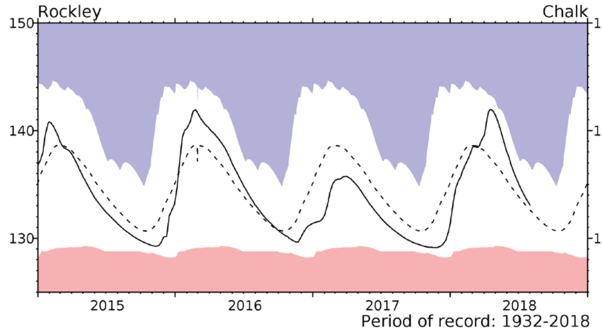
Groundwater . . . Groundwater

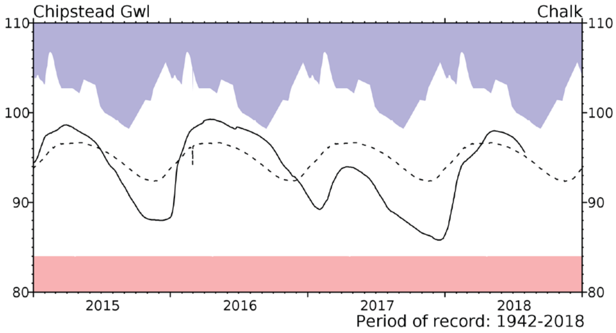


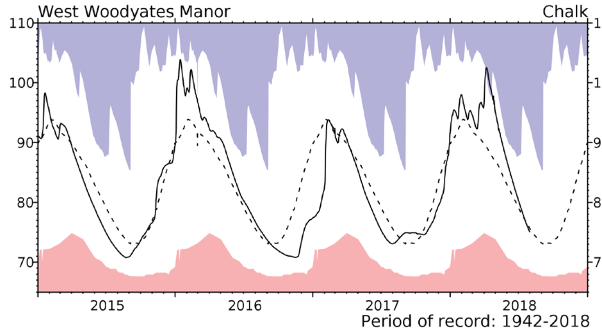


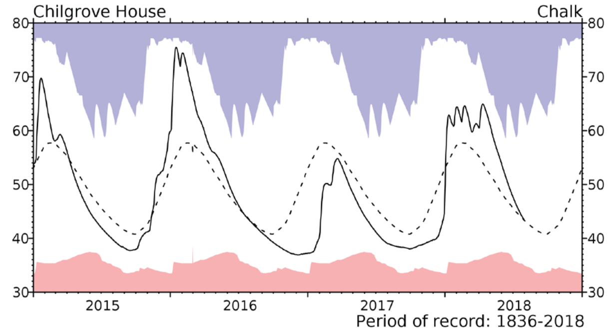


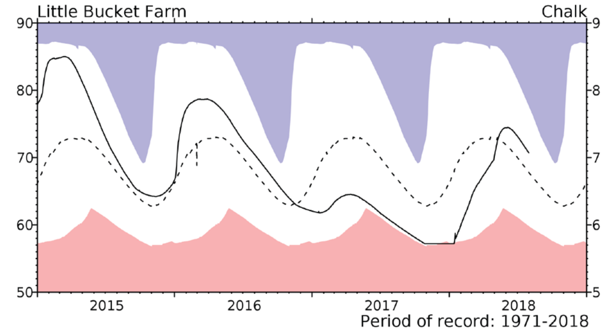


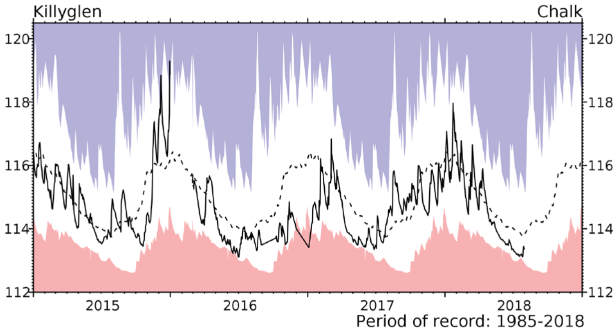






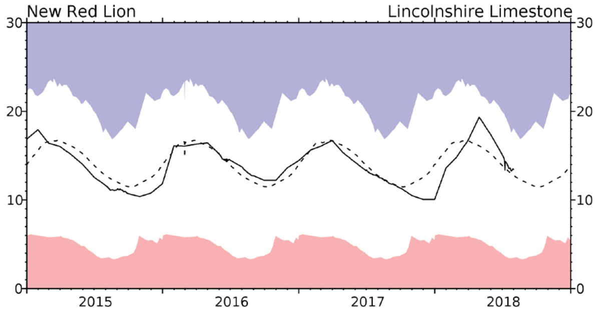




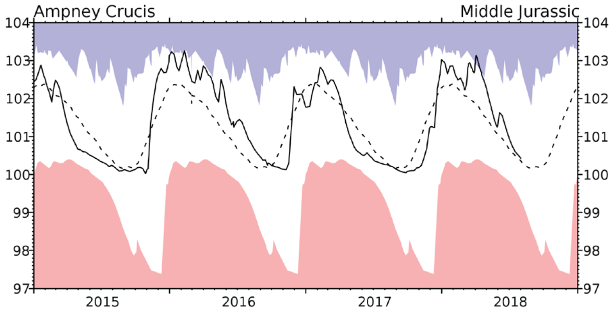


Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

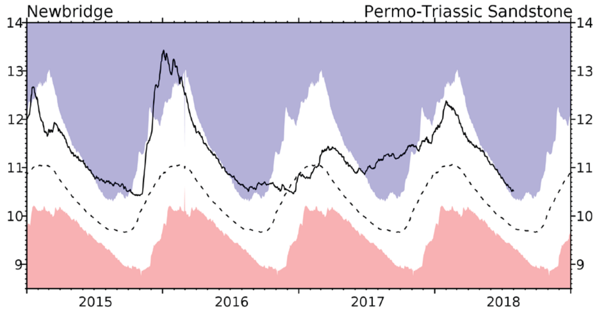
Groundwater ... Groundwater



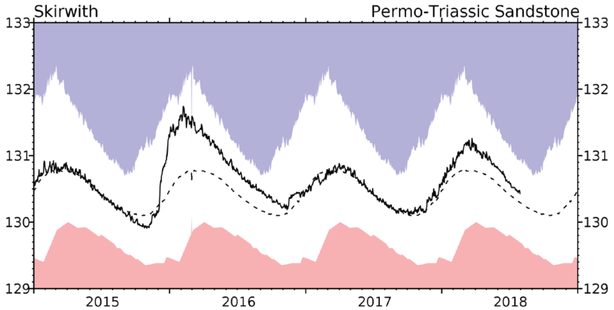
Period of record: 1939-2018



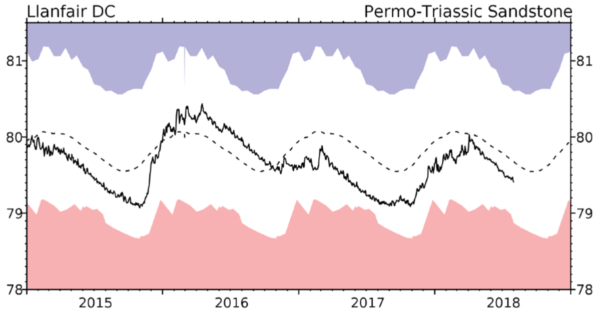
Period of record: 1958-2018



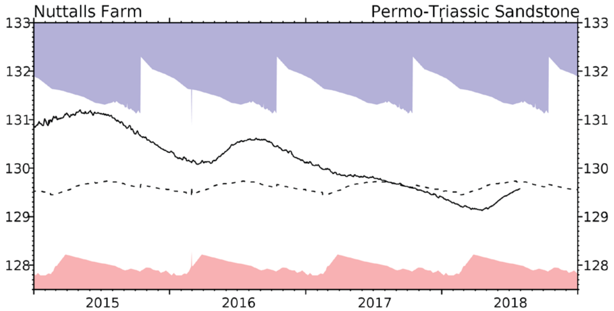
Period of record: 1993-2018



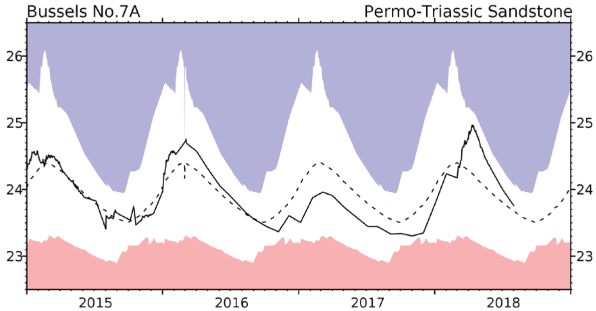
Period of record: 1978-2018



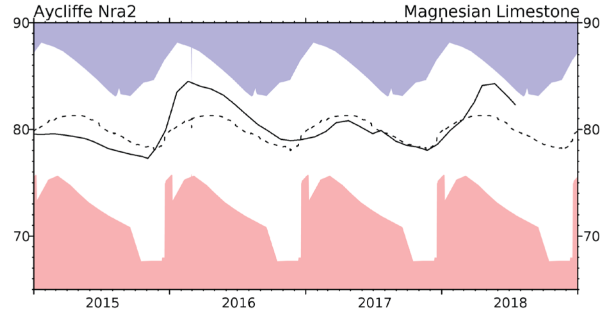
Period of record: 1972-2018



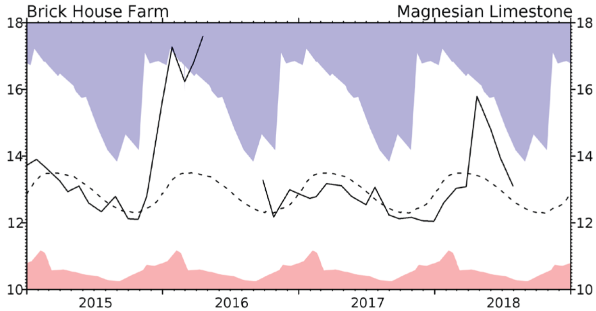
Period of record: 1974-2018



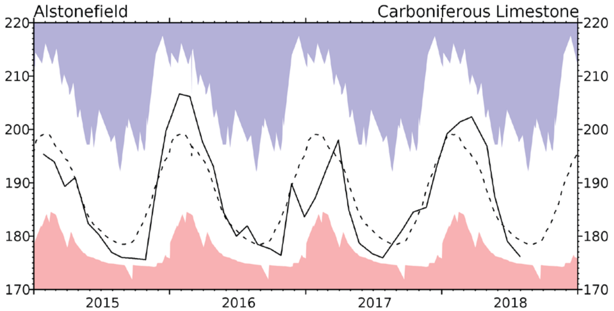
Period of record: 1971-2018



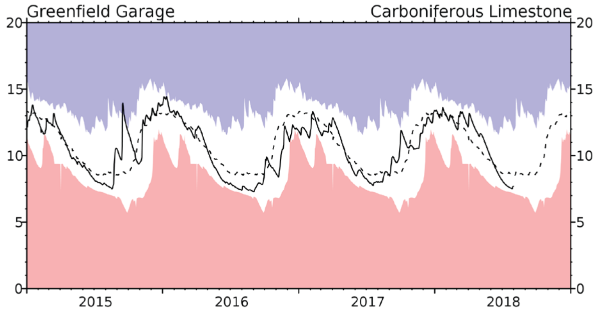
Period of record: 1968-2018



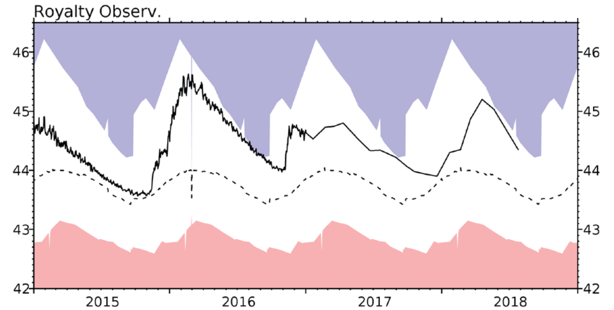
Period of record: 1939-2018



Period of record: 1974-2018

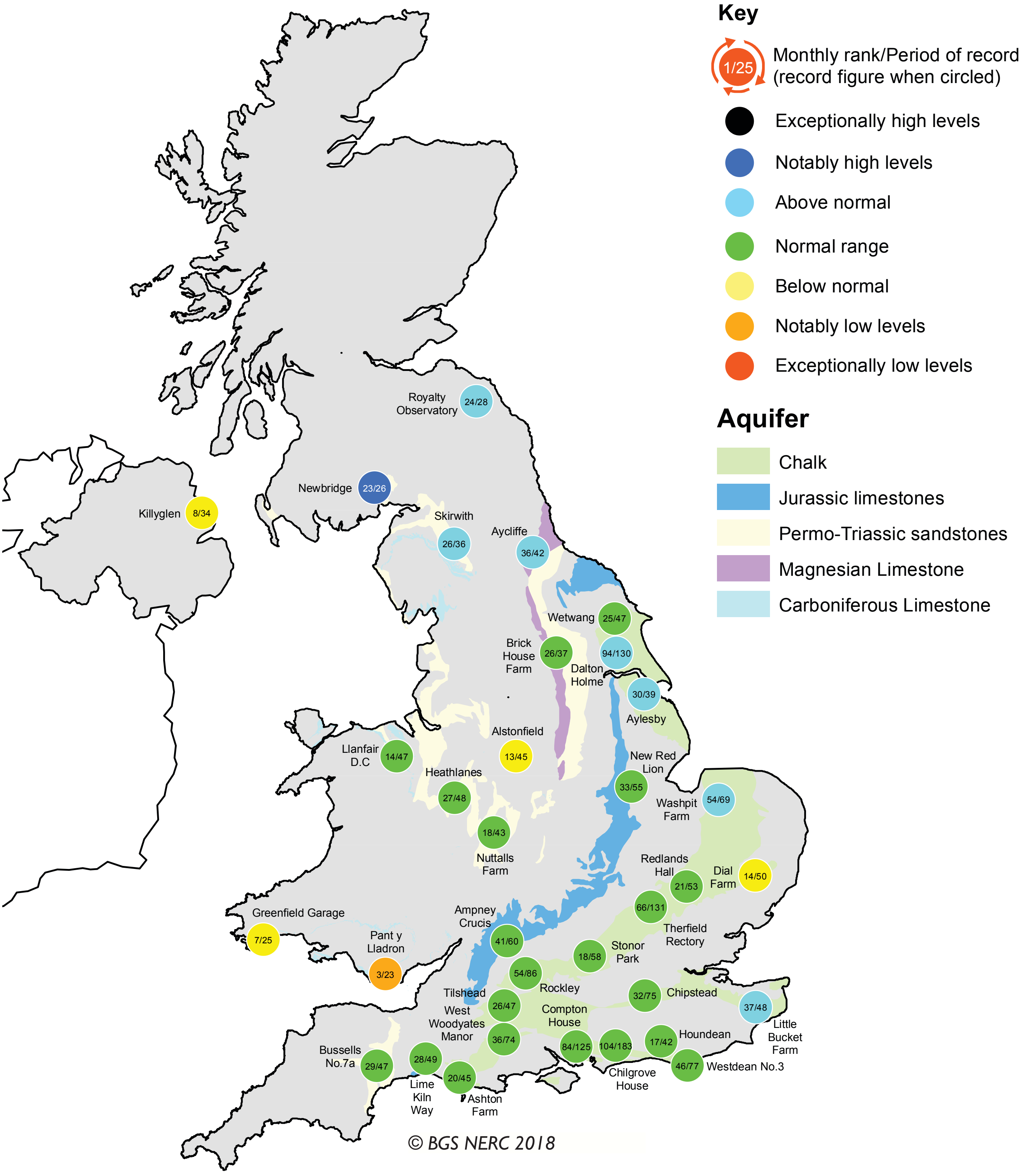


Period of record: 1994-2018



Period of record: 1990-2018

Groundwater…Groundwater

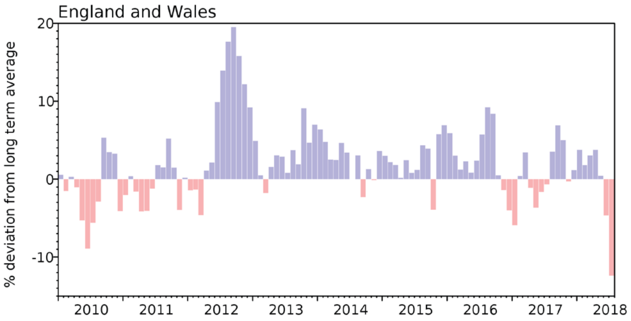


Groundwater levels - July 2018

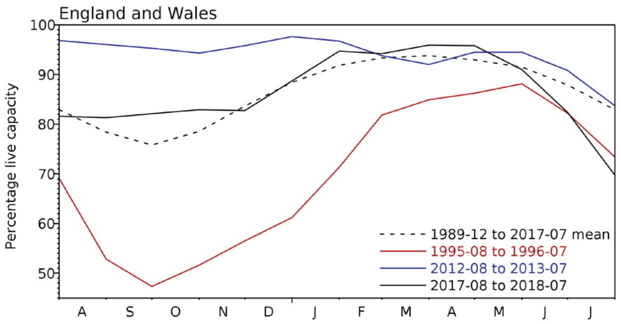
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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 May	2018 Jun	2018 Jul	Jul Anom.	Min Jul	Year* of min	2017 Jul	Diff 18-17
North West	N Command Zone	•	124929	69	57	41	-23	23	1984	72	-31
	Vyrnwy		55146	93	82	69	-8	45	1984	93	-24
Northumbrian	Teesdale	•	87936	82	71	61	-14	45	1989	81	-21
	Kielder		(199175)	91	87	77	-13	66	1989	89	-13
Severn-Trent	Clywedog		49936	100	93	72	-13	50	1976	82	-10
	Derwent Valley	•	46692	86	69	52	-22	43	1996	66	-15
Yorkshire	Washburn	•	23373	85	71	57	-17	50	1995	80	-23
	Bradford Supply	•	40942	84	67	52	-20	38	1995	72	-20
Anglian	Grafham		(55490)	92	90	83	-6	66	1997	94	-11
	Rutland		(116580)	96	94	89	3	74	1995	91	-1
Thames	London	•	202828	97	94	80	-7	73	1990	82	-3
	Farmoor	•	13822	98	95	98	2	84	1990	99	0
Southern	Bewl		31000	98	93	84	8	45	1990	56	28
	Ardingly		4685	100	91	80	-6	65	2005	84	-4
Wessex	Clatworthy		5364	93	72	59	-14	43	1992	65	-6
	Bristol	•	(38666)	93	85	71	-5	53	1990	72	-1
South West	Colliford		28540	98	88	75	-2	47	1997	74	1
	Roadford		34500	92	83	70	-8	46	1996	67	3
	Wimbleball		21320	98	86	73	-5	53	1992	63	10
	Stithians		4967	96	82	67	-4	39	1990	76	-9
Welsh	Celyn & Brenig	•	131155	96	86	71	-18	65	1989	88	-17
	Brianne		62140	94	83	71	-20	67	1995	97	-26
	Big Five	•	69762	88	72	58	-20	41	1989	81	-23
	Elan Valley	•	99106	93	77	62	-20	53	1976	68	-6
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	93	90	81	-2	51	1998	82	-1
	East Lothian	•	9374	99	94	83	-7	72	1992	100	-17
Scotland(W)	Loch Katrine	•	110326	88	80	62	-13	53	2000	83	-21
	Daer		22412	79	78	64	-18	56	2013	78	-15
	Loch Thom		10798	95	90	83	-2	59	2000	71	12
Northern Ireland	Total⁺	•	56800	88	75	68	-10	54	1995	84	-16
	Silent Valley	•	20634	86	72	64	-10	42	2000	82	-17

( ) figures in parentheses relate to gross storage

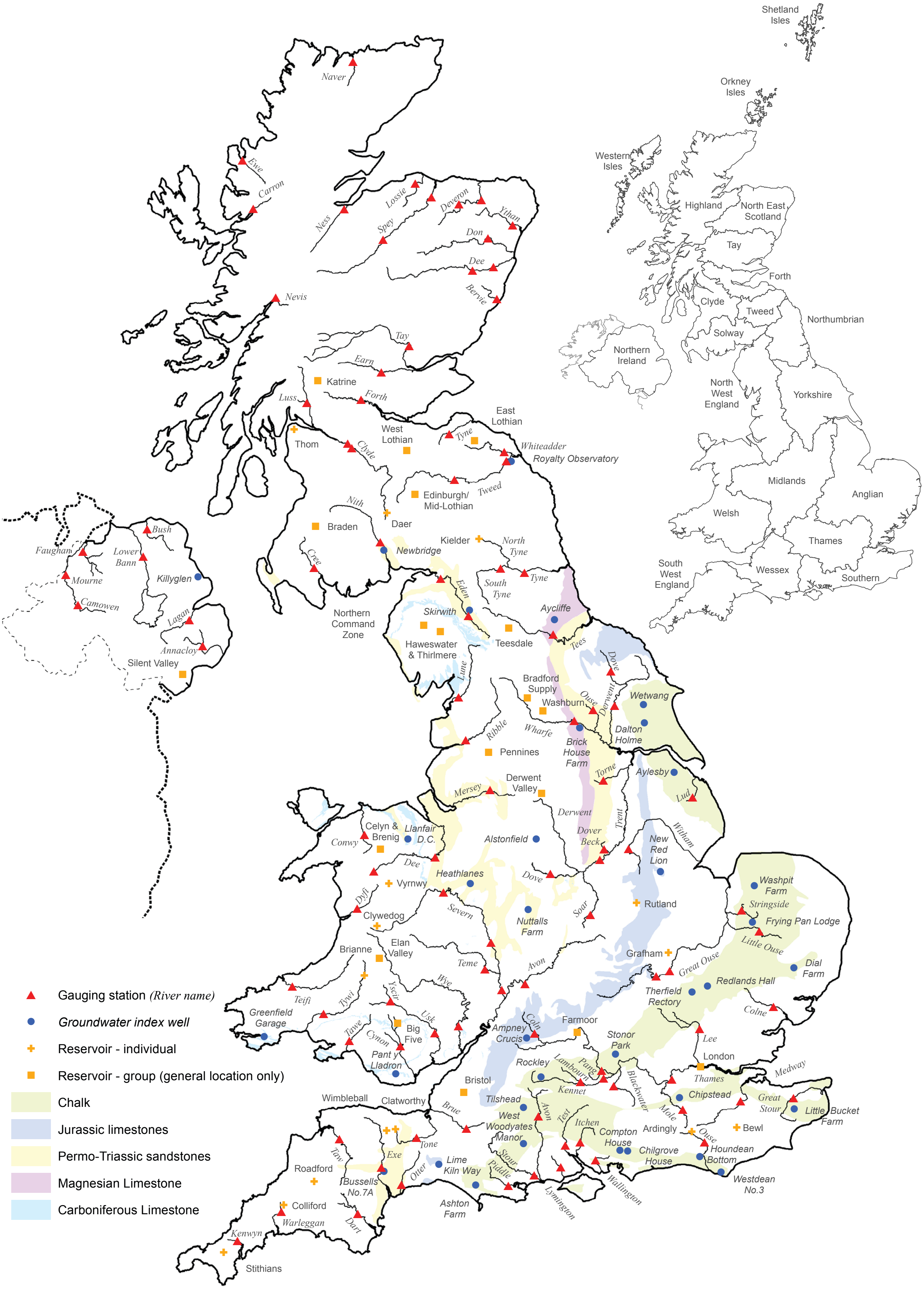
• denotes reservoir groups

*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.

The monthly rainfall figures are provided by the Met Office NCIC and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

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

Some of the features displayed on the maps contained in this report are based on the following data with permission of the controller of HMSO.

i. Ordnance Survey data. © Crown copyright and/or database right 2005. Licence no. 100017897.
ii. Land and Property Services data. © Crown copyright and database right, S&LA 145.
iii. Met Office rainfall data. © Crown copyright.

08/2018

NERC SCIENCE OF THE ENVIRONMENT