Hydrological Summary

for the United Kingdom

July 2021

General

Changeable conditions with heavy rain and showers bookended a settled and warm period in July. It was the fifth warmest July for the UK (in a series from 1884) and a record maximum temperature for Northern Ireland of 31.3°C was recorded on the 21st at Castlederg (County Tyrone). During the settled period, temperatures regularly exceeded 30°C and the Met Office issued the first amber heat warning (the system began operation in June 2021) for unusually high temperatures in western areas. Although July rainfall totals were near average for the UK, there was a stark contrast between drier conditions in most northern and western areas and wet weather elsewhere. This distribution was reflected in river flows with above normal flows in southern and central England and below normal flows in Wales, northern England and Northern Ireland. Soils were drier than average across the UK, except in the Southern and North-East regions in England. The seasonal groundwater recession continued at the vast majority of sites, and levels in the Chalk and Carboniferous Limestone aquifers were in the normal range. Above normal levels were observed in northern England, with record high July levels in two boreholes. Reservoir stocks at the national scale fell to below average for July, with some impoundments in Scotland (Daer and Lochs Katrine and Thom) ending the month at just over half of capacity. A continued period of rainfall is required to ameliorate soil moisture deficits in parts of north-east Scotland and campaigns persist to encourage reduced water usage. Continued caution is also required in areas dependent on surface water supplies in Wales, Northern Ireland and north-west England.

Rainfall

The first twelve days of July were unsettled, with thunderstorms, heavy rain and showers leading to surface water flooding and travel disruption in many areas of Scotland, Northern Ireland and in north-west and south-west England (e.g. 55mm was recorded in Plymouth on the 3rd). On the 9th, localised heavy rainfall led to flooding and evacuations in Peterborough and Norwich, and the London Fire Brigade received over 1,000 calls in one day regarding property flooding. From the 13th, high pressure prevailed, bringing more settled and warmer weather. Convective weather returned for the final 10 days of July and roads, railways and homes, including a number of Underground stations in London flooded as a result of heavy rainfall (e.g. 42mm fell at St. James Park on the 25th). On the 30th, storm 'Evert' brought unsettled conditions and high winds, causing power outages and travel disruption across southern England. For the UK as a whole, July rainfall was near-average, with above average rainfall recorded in southern and central England and north-eastern Scotland (with more than 170% in these areas). Conversely, rainfall was below average in Northern Ireland, western Scotland and the borders, across much of Wales and the East Anglian coast. Some areas of Scotland recorded less than 30% of average and the Clyde region recorded its driest July on record (in a series from 1910). For the summer so far (June-July), below average rainfall dominated the UK, particularly in northern and western Britain, with above average rainfall confined to southern England. Rainfall deficits can be traced back to the start of 2021 in Northern Ireland and western Scotland.

River flows

Following recessions at the end of June, flows across the UK rose to above average at the start of July. On the 4th, the Dart recorded its third highest peak flow for July (in a series from 1959). Recessions commenced as settled weather took hold mid-month, and flows in many catchments dropped to below average. A new July daily minima was recorded on the Lagan (in a series from 1980). As convective rainfall returned towards month-end, flows responded rising once again to above average in southern Britain. National outflow series reflected the general rainfall patterns: monthly outflows in English Lowlands were above average, whilst recessions continued in Wales and Northern Ireland. July outflows from Northern Ireland were the third lowest on record (in a series from 1980). July monthly mean flows were above normal in southern and central England (e.g. the Blackwater recorded its third highest July monthly mean flow in a series from 1952). Elsewhere, flows in northern and western Britain were below normal, notably so in Northern Ireland, north Wales, and north-west England. Flows on the Cumbrian Derwent, Cumbrian Leven, and the Annacloy recorded a quarter of their respective averages. For June-July, flows followed a similar pattern to those in July, with exceptionally low flows on the Cumbrian Leven.

Groundwater

Soil Moisture Deficits increased during July over much of England, northern Wales and southern Scotland, whilst decreases were evident in northern Scotland, southern Wales and the Pennines. Groundwater levels in the Chalk continued to recede and were in the normal range, with the exception of Killyglen which was below normal, and two sites in the east of England (Washpit Farm and Little Bucket Farm) where levels were above normal. Recharge occurred at both Compton and Chilgrove in southern England due to the high rainfall. Levels fell in the Jurassic limestones but were above normal for July. Levels also fell in the Magnesian Limestone but a record monthly high was recorded (for the second time this year) at Brick House Farm; levels were also exceptionally high at Aycliffe. Normal levels, amid ongoing seasonal recession, were observed in all index sites in the Carboniferous Limestone and recessions continued in the Permo-Triassic sandstones, where levels were normal or above normal. Exceptionally high levels were recorded at Llanfair D.C. and Skirwith, and a third successive record monthly maximum was set at Weir Farm. Levels fell but remained notably high in the Upper Greensand at Lime Kiln Way, and fell but remained above normal in the Fell Sandstone at Royalty Observatory.

Note that due to continuing issues with data access, no data are available for Scotland.

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

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

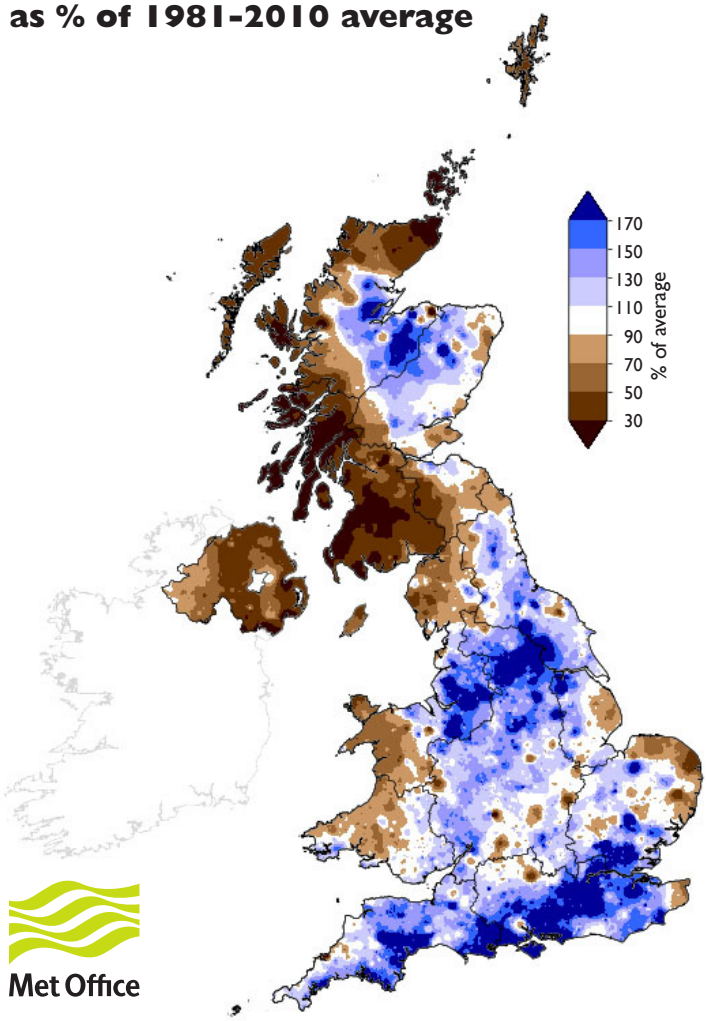
Region	Rainfall	Jul 2021	Jun21 – Jul21	RP	May21 – Jul21	RP	Feb21 – Jul21	RP	Aug20 – Jul21	RP
United Kingdom	mm	**73**	116		235		442		1215	
	%	**96**	79	5-10	110	2-5	95	2-5	108	5-10
England	mm	**78**	126		238		372		983	
	%	**128**	103	2-5	132	8-12	103	2-5	117	8-12
Scotland	mm	**66**	106		215		527		1494	
	%	**71**	60	30-50	84	5-10	87	2-5	98	2-5
Wales	mm	**80**	112		322		590		1647	
	%	**88**	65	5-10	126	5-10	105	2-5	116	10-15
Northern Ireland	mm	**43**	83		199		405		1172	
	%	**53**	52	60-90	86	2-5	84	2-5	103	2-5
England & Wales	mm	**79**	124		249		401		1074	
	%	**120**	96	2-5	131	5-10	103	2-5	116	10-15
North West	mm	**96**	121		253		522		1438	
	%	**111**	72	5-10	106	2-5	105	2-5	117	10-20
Northumbria	mm	**75**	98		196		373		998	
	%	**111**	73	2-5	104	2-5	98	2-5	115	5-10
Severn-Trent	mm	**75**	107		225		340		891	
	%	**124**	87	2-5	125	5-10	98	2-5	114	5-10
Yorkshire	mm	**90**	114		238		389		1004	
	%	**148**	89	2-5	131	5-10	105	2-5	119	8-12
Anglian	mm	**56**	108		191		274		722	
	%	**106**	102	2-5	122	5-10	96	2-5	116	5-10
Thames	mm	**70**	142		241		330		869	
	%	**136**	139	5-10	152	15-25	107	2-5	122	10-20
Southern	mm	**79**	178		262		356		943	
	%	**160**	179	15-25	172	80-120	111	2-5	118	5-10
Wessex	mm	**83**	135		254		381		986	
	%	**143**	119	2-5	146	10-20	105	2-5	112	2-5
South West	mm	**109**	174		353		532		1416	
	%	**138**	116	2-5	157	20-30	107	2-5	115	5-10
Welsh	mm	**80**	113		318		573		1597	
	%	**91**	67	5-10	127	5-10	105	2-5	117	10-20
Highland	mm	**78**	120		217		582		1622	
	%	**77**	62	20-35	78	8-12	81	2-5	90	2-5
North East	mm	**102**	123		256		439		1129	
	%	**139**	86	2-5	122	2-5	102	2-5	111	5-10
Tay	mm	**93**	126		278		585		1464	
	%	**112**	79	2-5	117	2-5	108	2-5	109	5-10
Forth	mm	**65**	103		215		468		1298	
	%	**80**	65	8-12	94	2-5	94	2-5	108	5-10
Tweed	mm	**54**	82		200		426		1174	
	%	**70**	56	10-20	94	2-5	98	2-5	115	10-15
Solway	mm	**38**	69		198		525		1561	
	%	**39**	38	>100	75	5-10	88	2-5	105	5-10
Clyde	mm	**35**	95		186		561		1794	
	%	**31**	45	>100	62	30-50	78	5-10	98	2-5

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

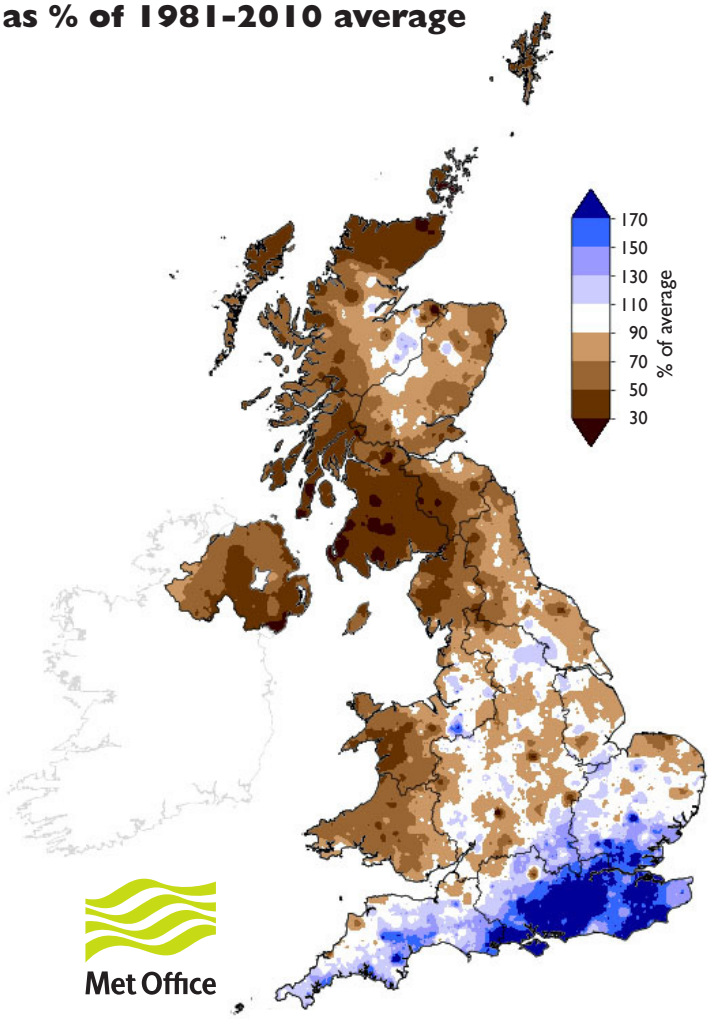
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

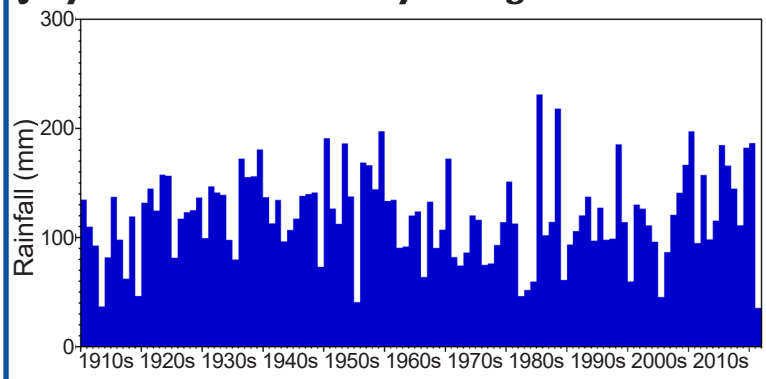
July 2021 rainfall
as % of 1981-2010 average



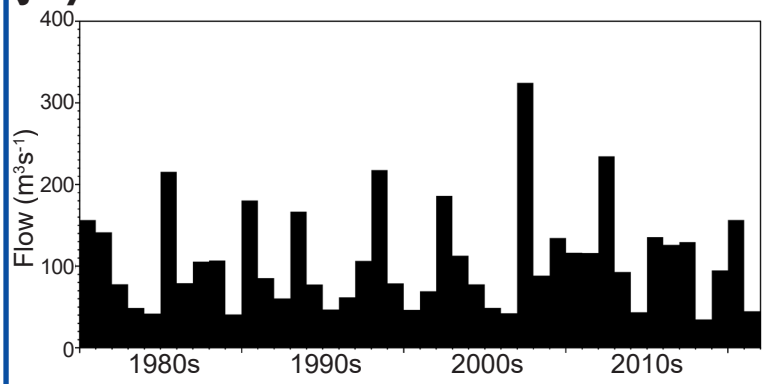
June 2021 - July 2021 rainfall
as % of 1981-2010 average



July rainfall for the Clyde region



July mean outflows for Northern Ireland



Hydrological Outlook UK

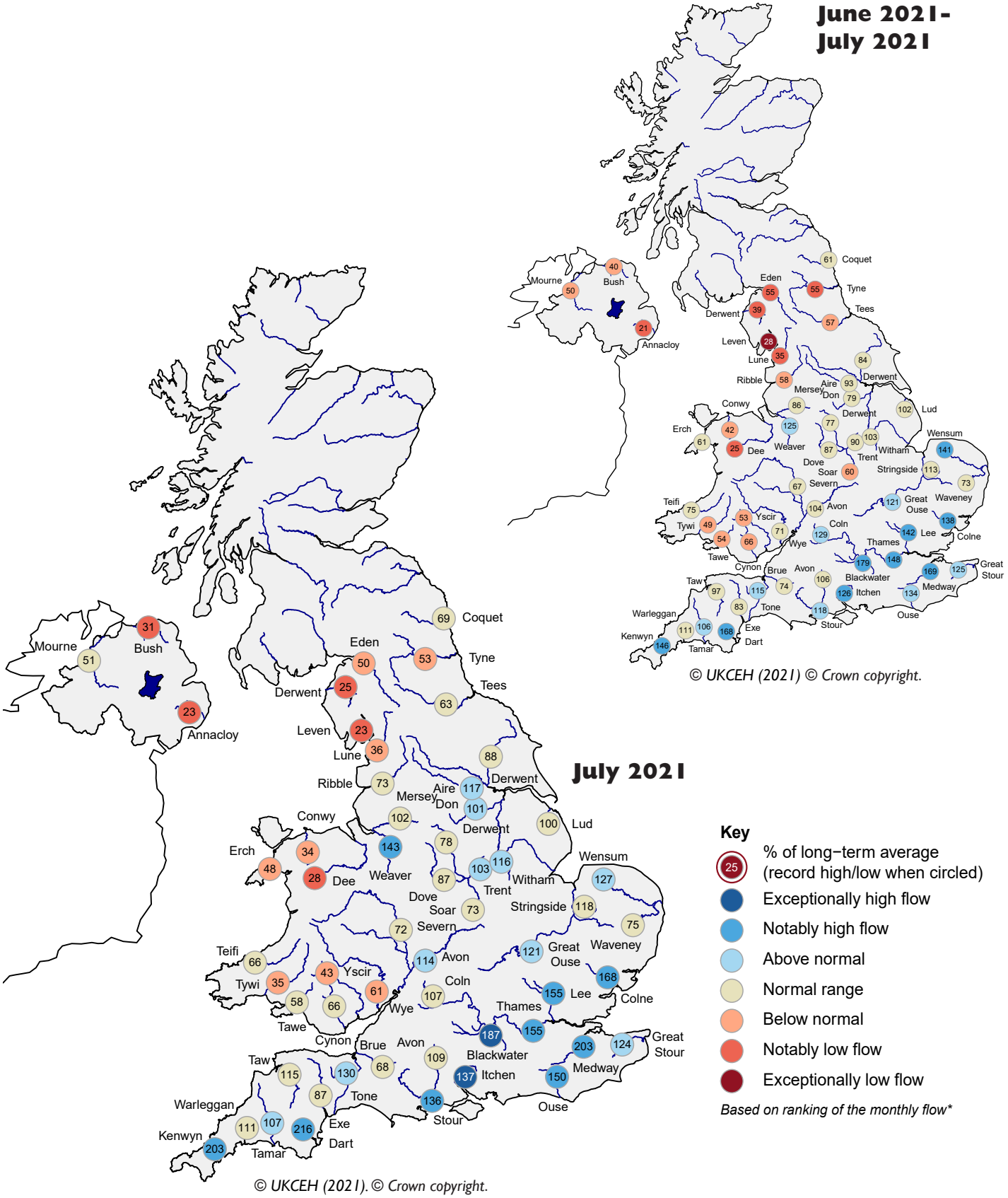
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

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

Period: **from August 2021**
Issued: **09.08.2021**
using data to the end of July 2021

In August river flows to the northwest of the UK and Wales, are most likely to be normal, but with a possibility of below normal flows. Elsewhere, river flows are likely to be normal to above normal. Groundwater levels are expected to be above normal in northern aquifers, and in the normal range in southern aquifers. Over the three month period to October a return to more normal conditions is expected for both river flows and groundwater levels.

River flow . . . River flow . . .

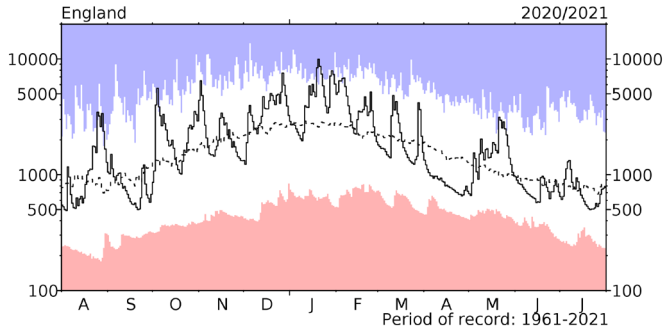


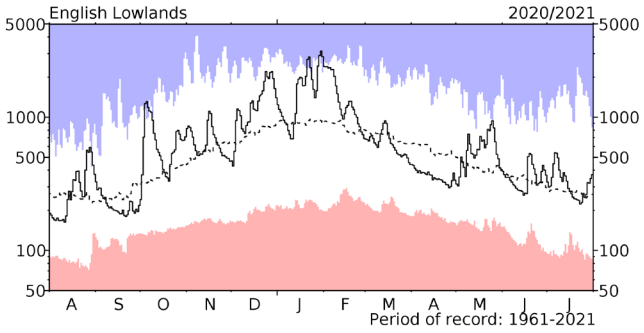
River flows

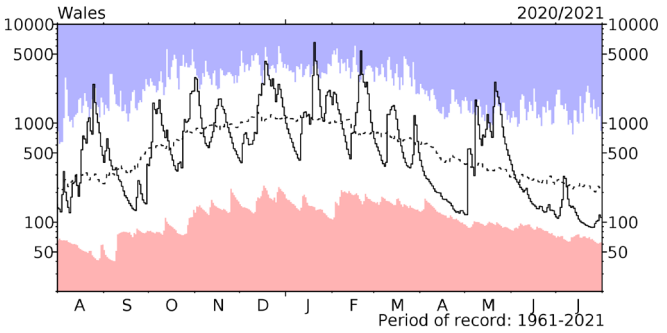
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

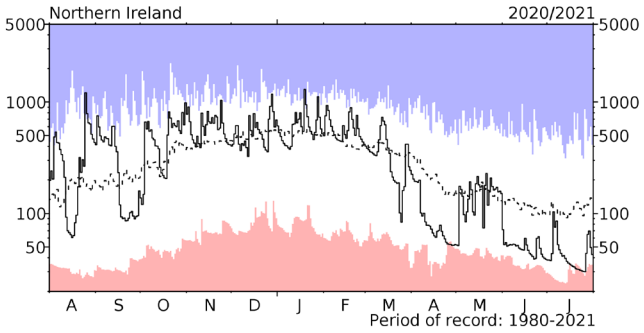
Note that due to continuing issues with data access, no data are available for Scotland.

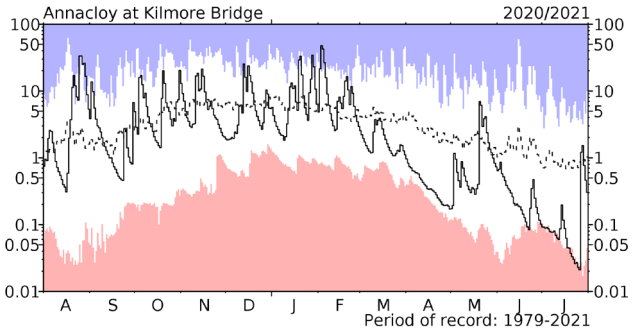
River flow . . . River flow . . .

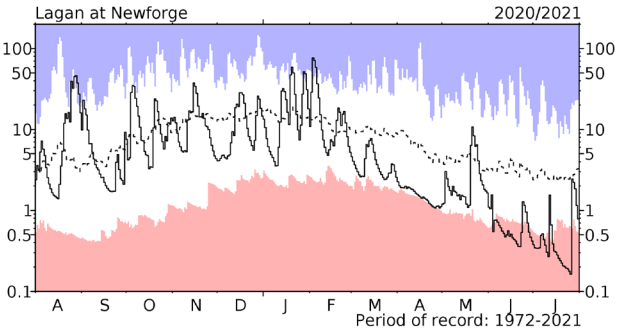


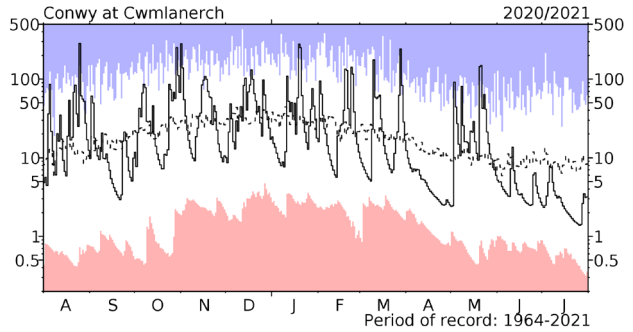


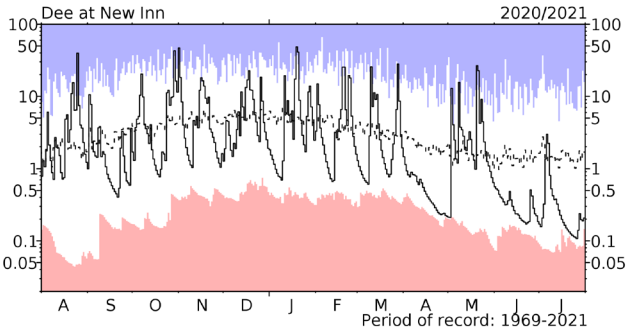


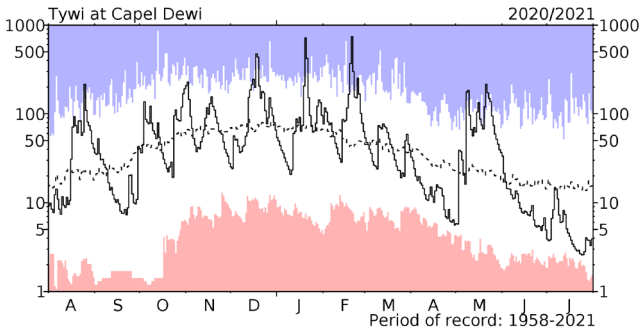


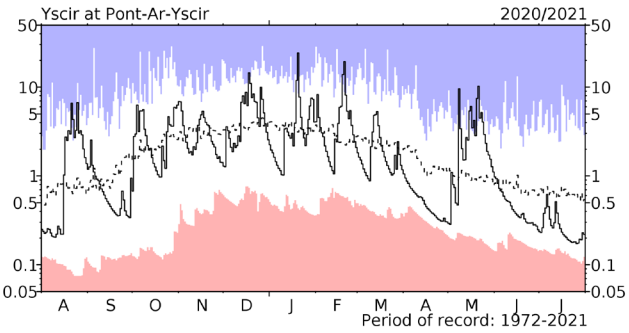








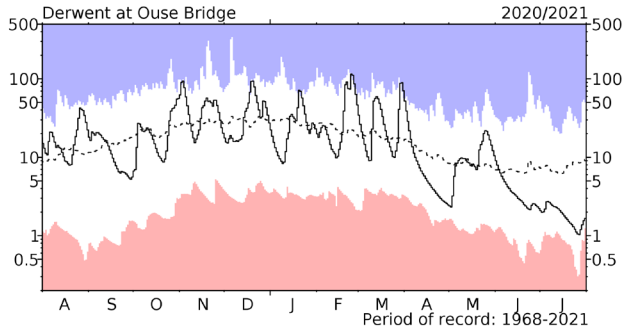


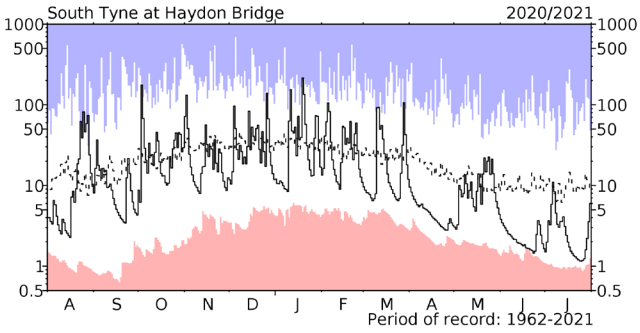


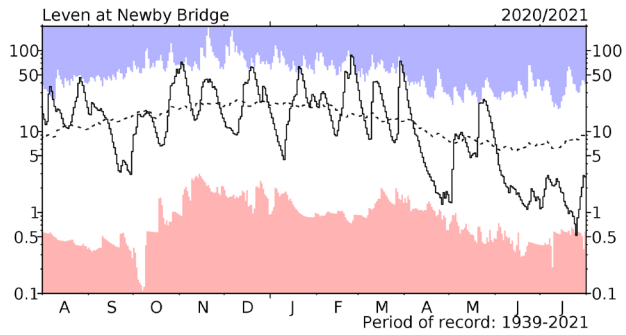
River flow hydrographs

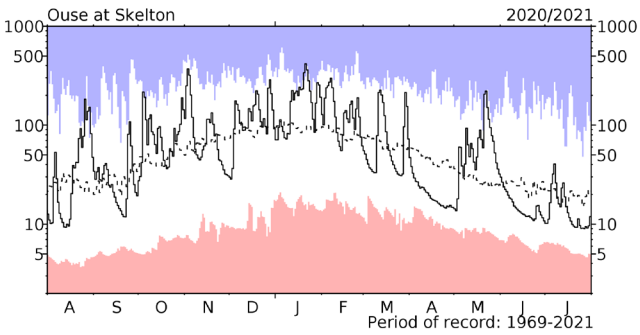
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to August 2020 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

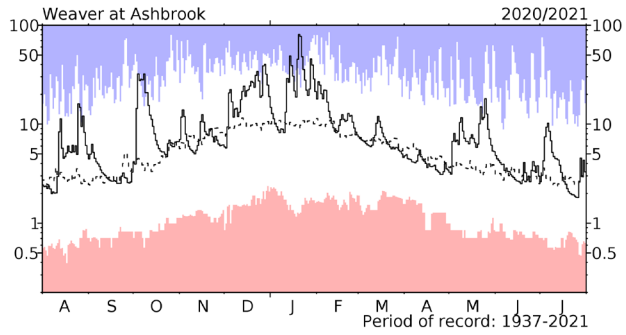
River flow . . . River flow . . .

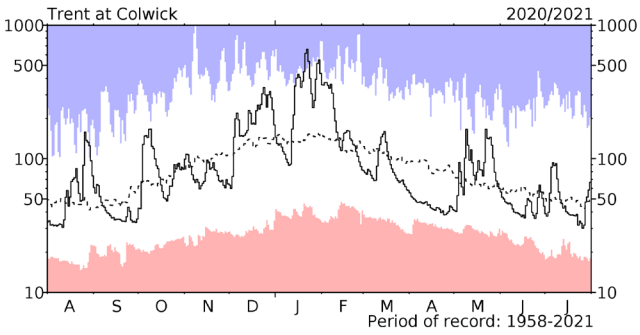


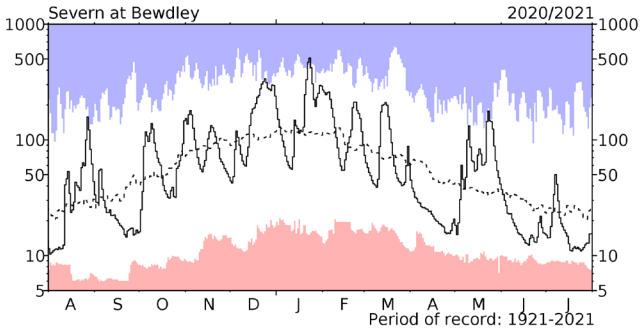


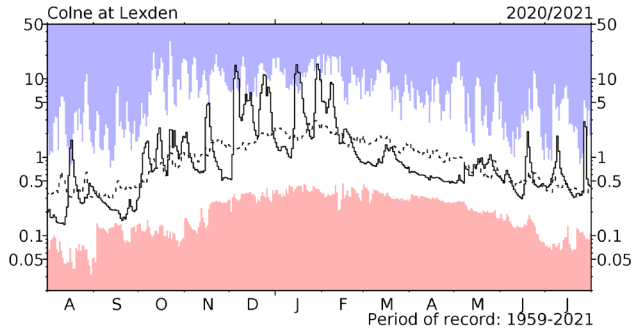


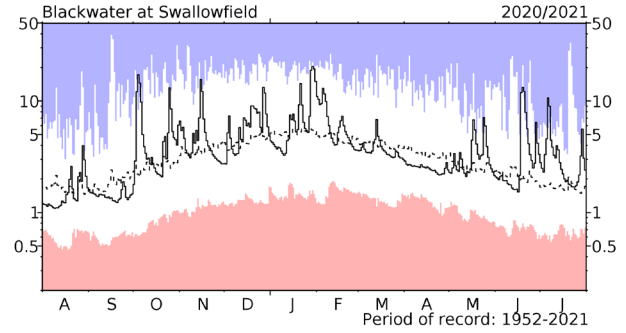


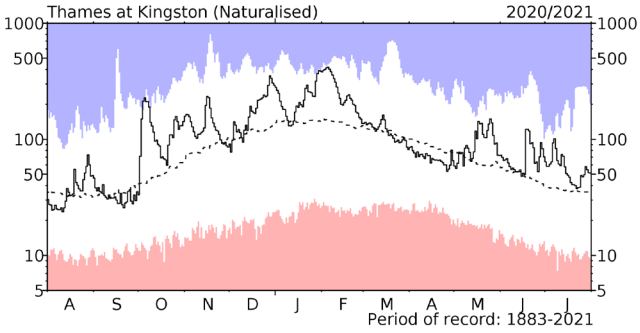


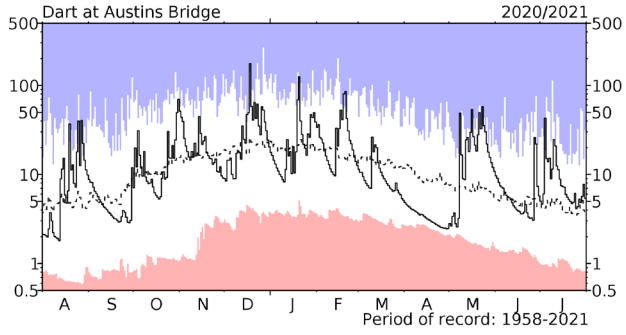


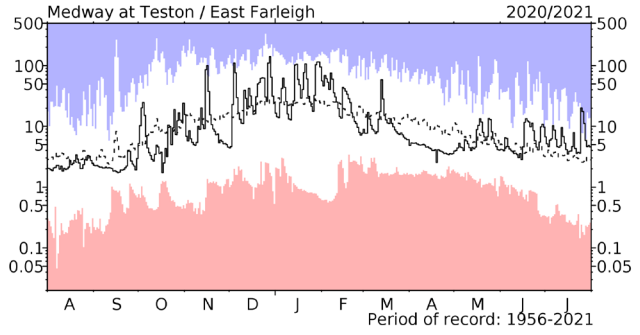




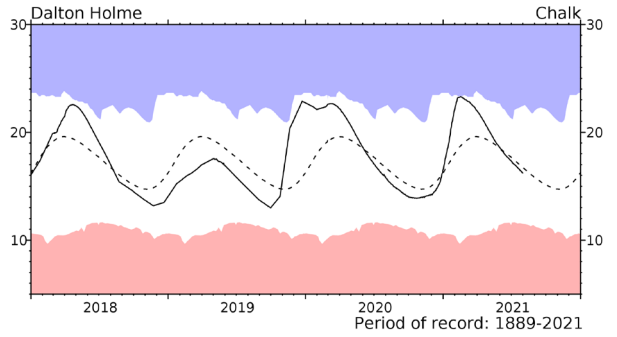


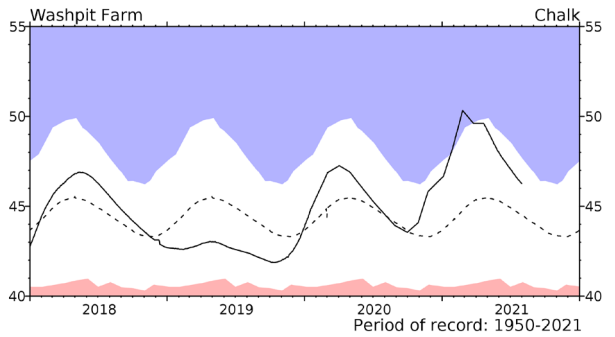


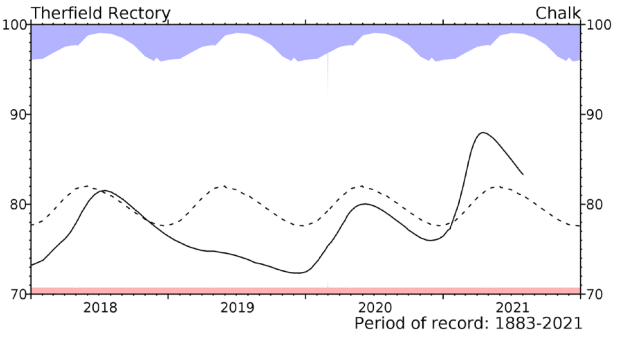


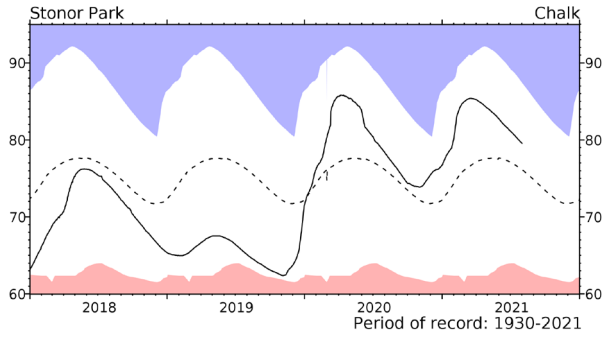


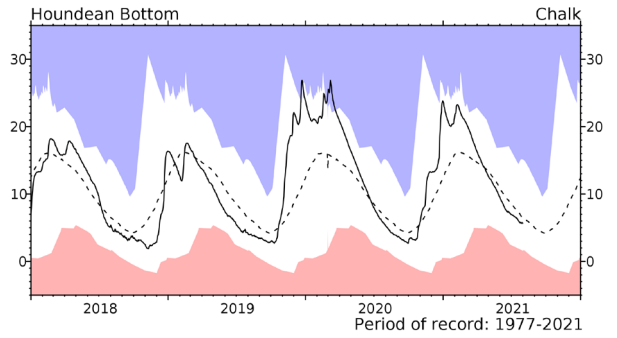
Groundwater…Groundwater

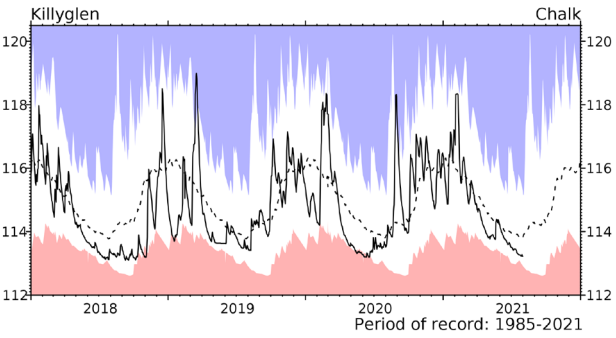


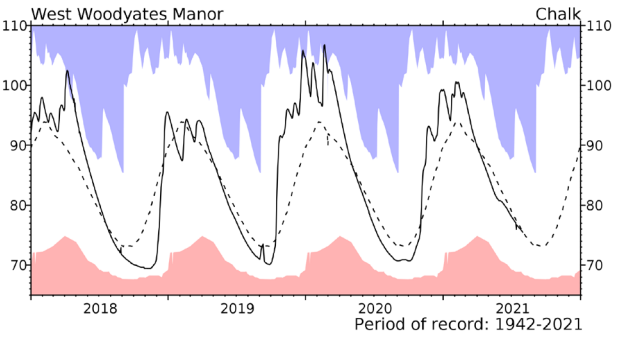


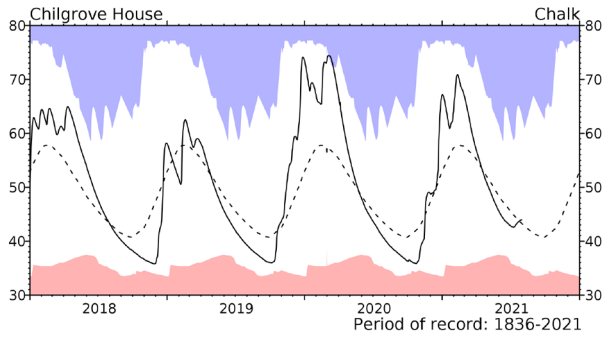


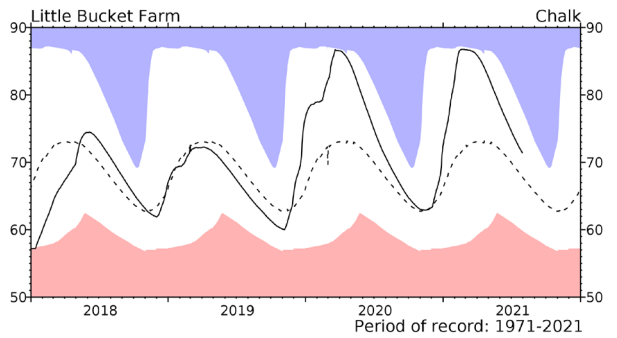


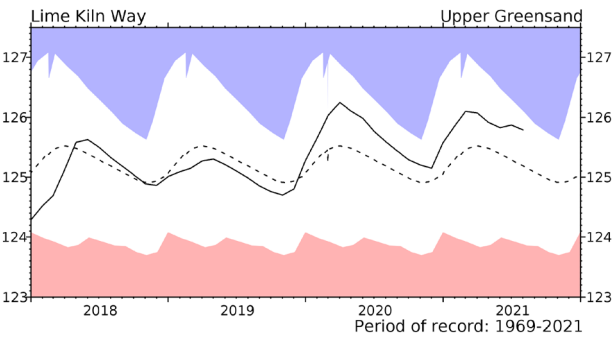






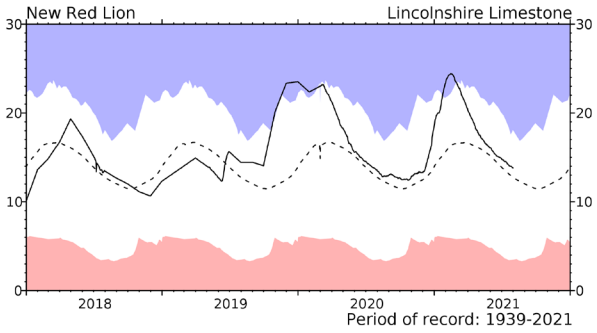




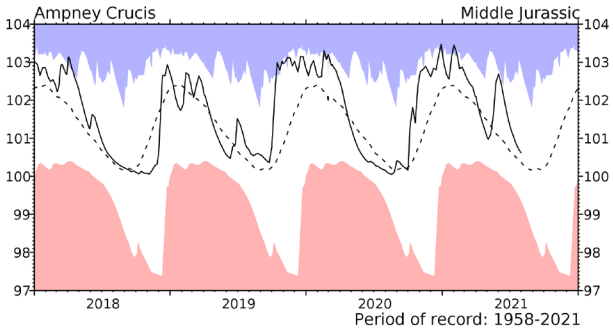


Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is 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 calculated with data from the start of the record to the end of 2017. 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.

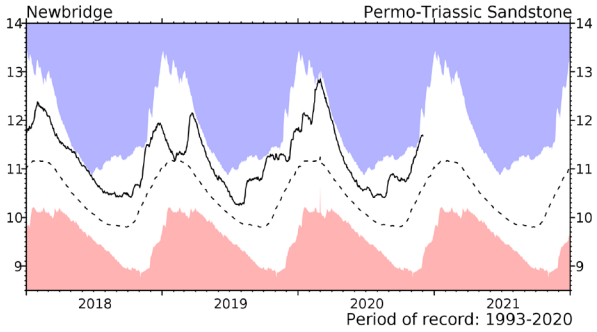
Groundwater… Groundwater



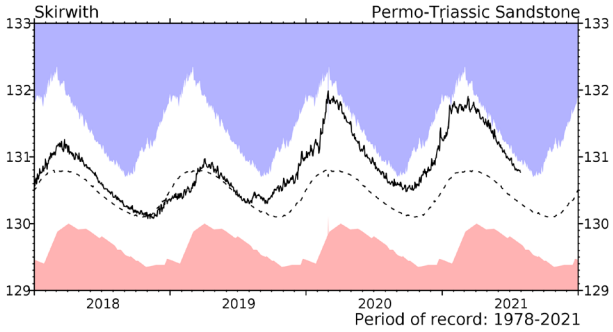
Period of record: 1939-2021



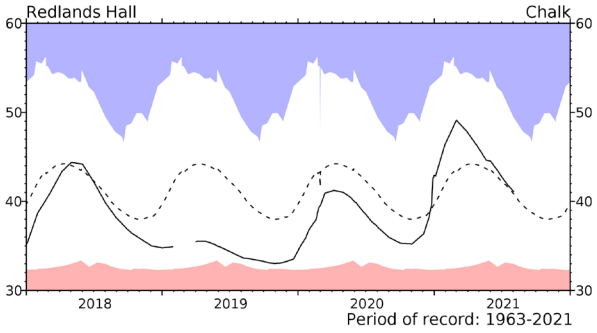
Period of record: 1958-2021



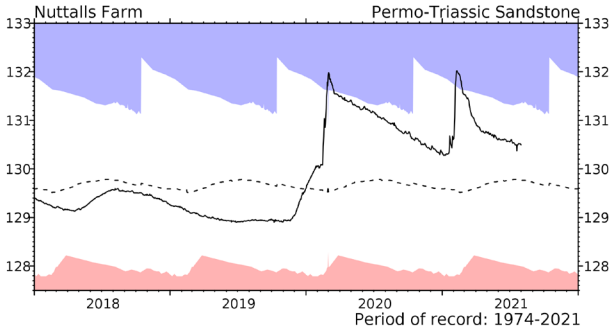
Period of record: 1993-2020



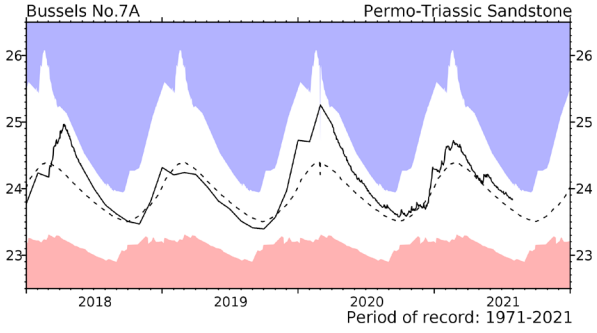
Period of record: 1978-2021



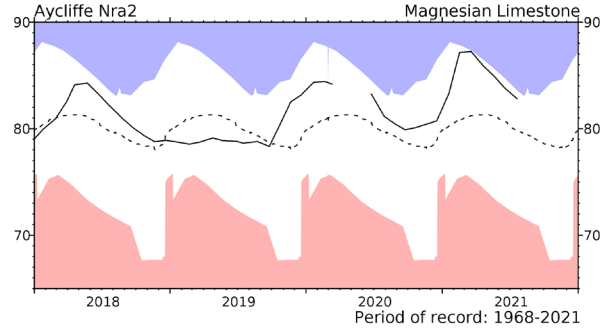
Period of record: 1963-2021



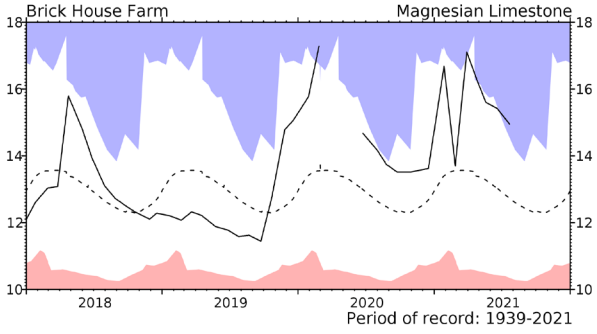
Period of record: 1974-2021



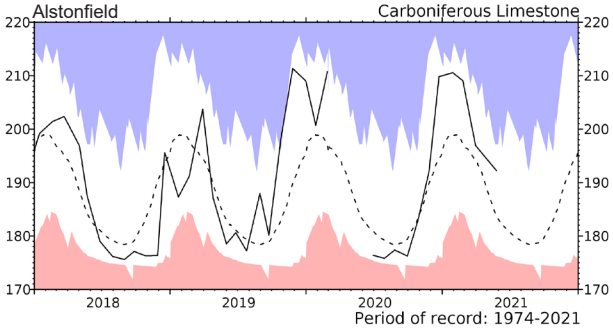
Period of record: 1971-2021



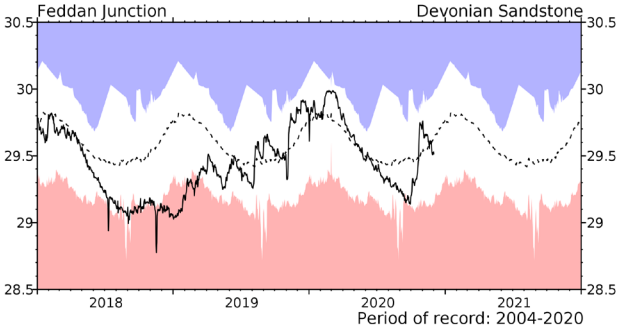
Period of record: 1968-2021



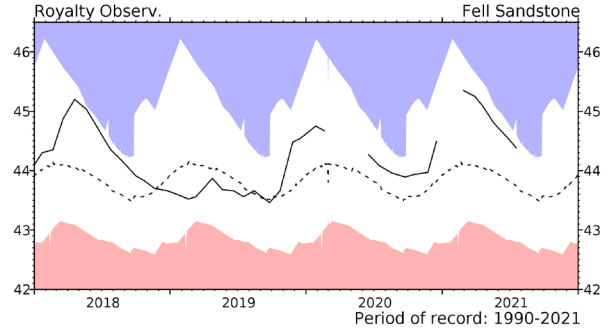
Period of record: 1939-2021



Period of record: 1974-2021

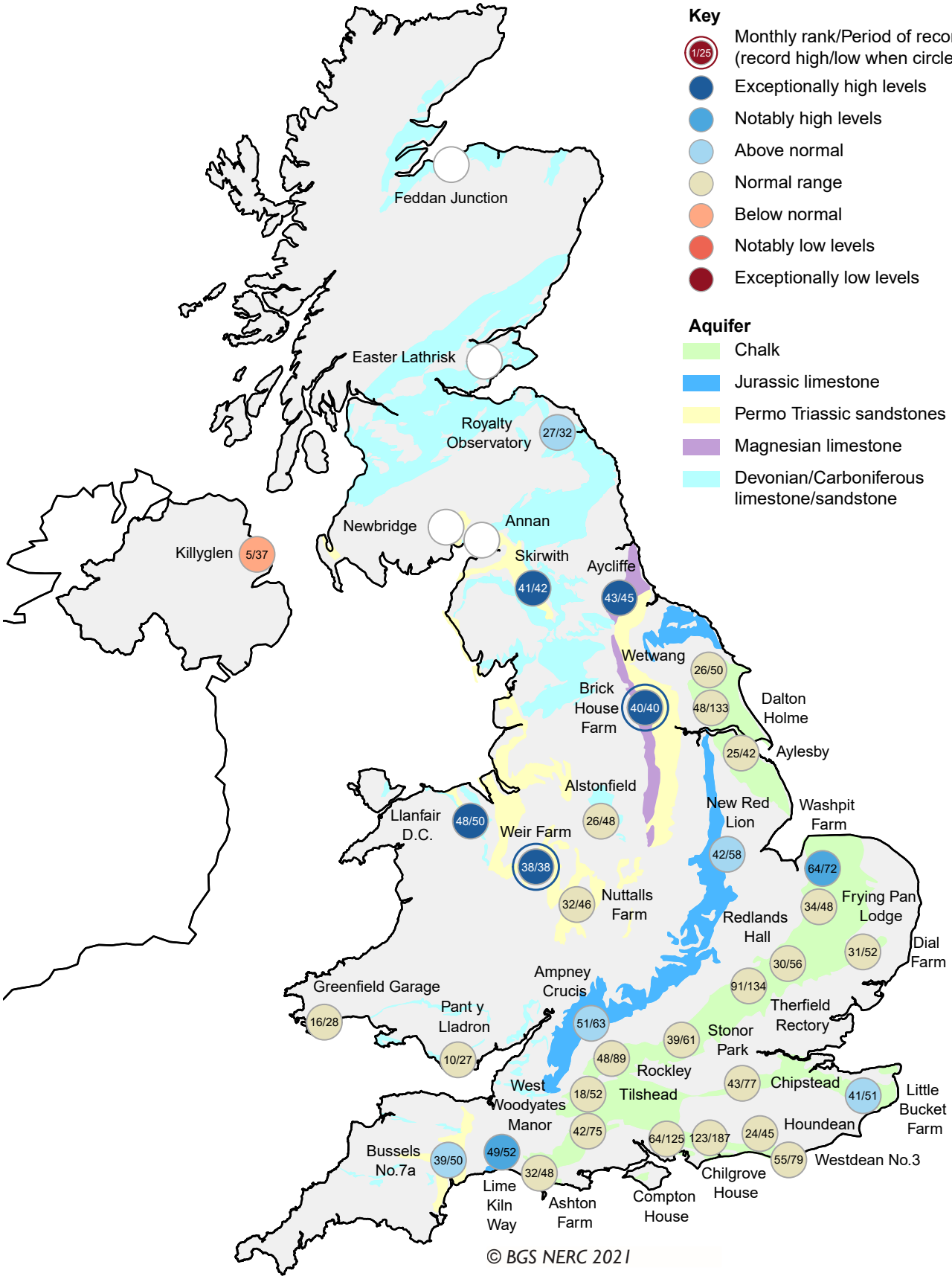


Period of record: 2004-2020



Period of record: 1990-2021

Groundwater…Groundwater



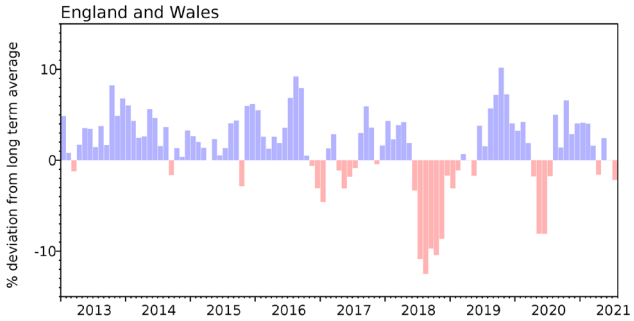
Groundwater levels - July 2021

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.

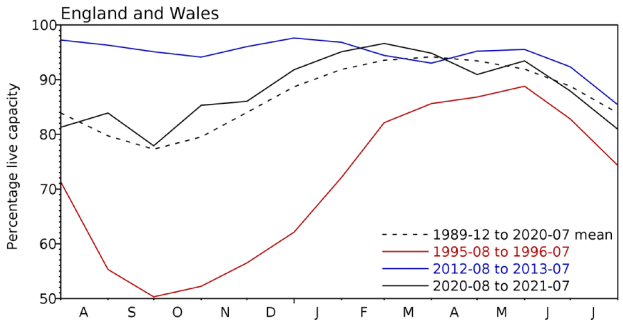
Note that due to continuing issues with data access, no data are available for Scotland.

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)	2021 May	2021 Jun	2021 Jul	Jul Anom.	Min Jul	Year* of min	2020 Jul	Diff 21-20
North West	Haweswater & Thirlmere	•	111132	85	67	65	-4	42	2018	65	0
	Pennines	•	126991	89	76	79	6	50	2018	79	0
Northumbria	Teesdale	•	87936	74	65	57	-17	45	1989	62	-5
	Kielder Water		(199175)	96	89	85	-4	66	1989	90	-5
Severn-Trent	Clywedog		49936	99	96	87	1	50	1976	93	-6
	Derwent Valley	•	46692	92	78	65	-8	43	1996	73	-8
Yorkshire	Washburn	•	23373	87	81	76	2	50	1995	77	-1
	Bradford Supply	•	40942	97	83	69	-3	38	1995	76	-7
Anglian	Grafham		(55490)	92	93	96	6	66	1997	92	4
	Rutland		(116580)	95	95	93	7	74	1995	93	1
Thames	London	•	202828	91	91	89	2	73	1990	90	-1
	Farmoor	•	13822	96	99	98	2	84	1990	98	0
Southern	Bewl		31000	90	87	82	5	45	1990	75	7
	Ardingly		4685	100	99	95	11	62	2020	62	33
Wessex	Clatworthy		5662	100	91	79	6	43	1992	62	17
	Bristol	•	(38666)	89	81	72	-3	53	1990	71	2
South West	Colliford		28540	87	83	77	0	47	1997	68	9
	Roadford		34500	93	90	87	10	46	1996	66	20
	Wimbleball		21320	98	97	84	7	53	1992	63	21
	Stithians		4967	88	82	74	4	39	1990	70	4
Welsh	Celyn & Brenig	•	131155	100	96	84	-4	65	1989	79	5
	Brianne		62140	93	86	78	-12	67	1995	91	-13
	Big Five	•	69762	92	81	66	-11	41	1989	69	-3
	Elan Valley	•	99106	98	87	73	-9	53	1976	70	3
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	92	82	74	-9	51	1998	84	-10
	East Lothian	•	9317	100	98	96	6	72	1992	87	9
Scotland(W)	Loch Katrine	•	110326	85	75	58	-18	53	2000	82	-24
	Daer		22494	85	68	54	-27	54	2021	98	-44
	Loch Thom		10721	73	65	55	-30	55	2021	76	-21
Northern Ireland	Total+	•	56800	91	80	66	-12	54	1995	77	-11
	Silent Valley	•	20634	87	76	59	-15	42	2000	71	-12

( ) figures in parentheses relate to gross storage

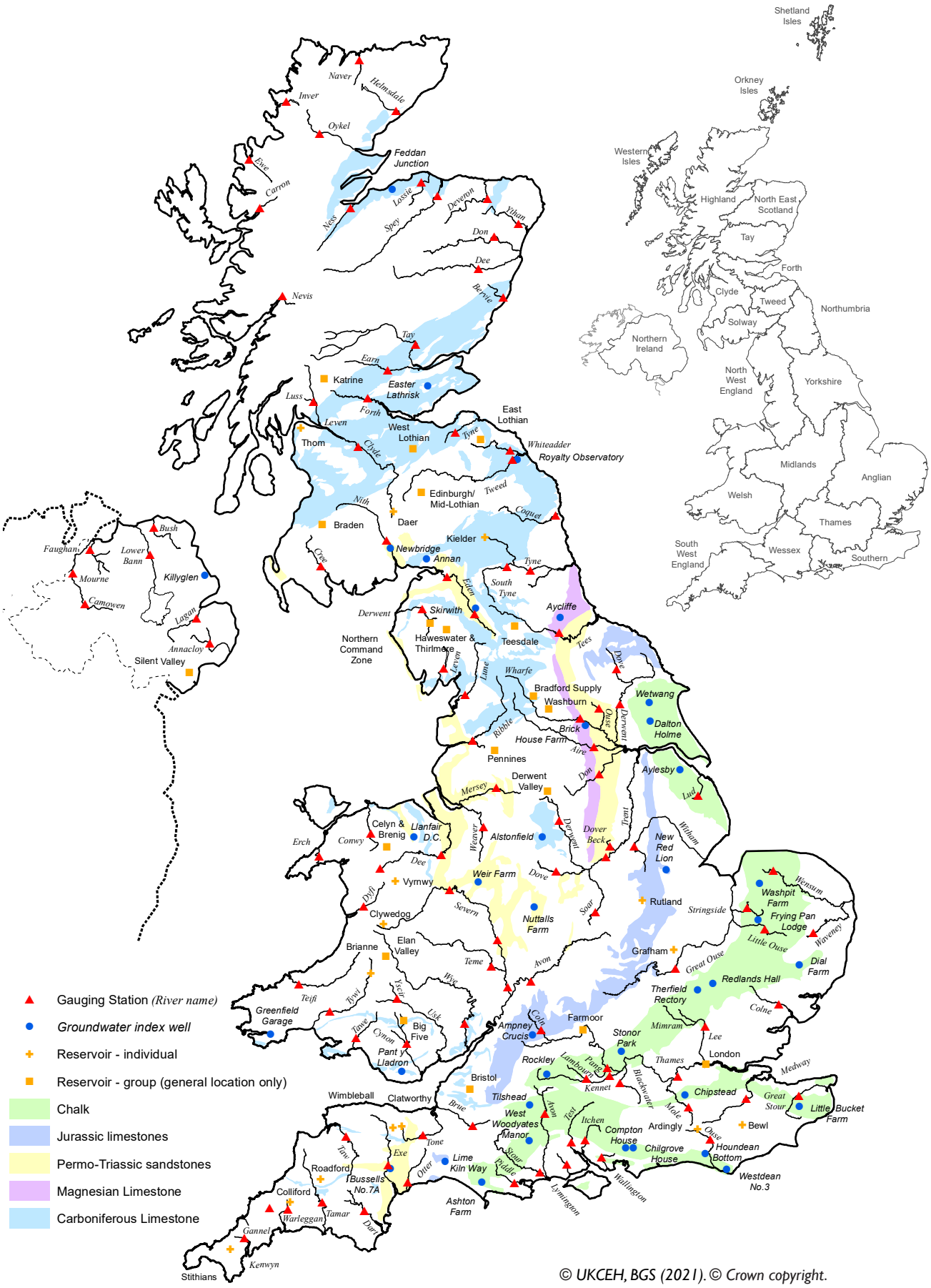
• denotes reservoir groups

*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 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. 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 https://doi.org/10.1002/joc.1161

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

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