# Hydrological Summary
## *for the United Kingdom*

*February 2019*

### General
February was a month of contrast in which unsettled, initially wintry conditions were followed by a dry period of unseasonable warmth. It was the second warmest February since 1910 for the UK (6.1°C), and new winter maxima, set at Trawsgoed on the 25th (20.6°C) and then at Kew Gardens a day later (21.2°C), both eclipsed the previous record by a wide margin. Rainfall totals were below average for the UK as a whole, compounding the dry January and resulting in a below average accumulation for the three winter months (78% of average). River flows were widely in the normal range, although above normal in Cumbria and below normal in the south and east, and notably below normal in the north east of England. Reservoir stocks increased, but Derwent Valley, Bradford Supply, Grafham and Roadford remained significantly below normal. Month-end Soil Moisture Deficits (SMDs) increased and were above average for England, Scotland and Northern Ireland. Groundwater levels generally ended February below normal, and were still receding at many boreholes. Notwithstanding healthy reservoir stocks and a wet start to March, further rain is needed over the next six weeks to counter long-term rainfall deficits and reduce the risk of pressure on water resources later in the year in large parts of England.

### Rainfall
A cold and then unsettled start to February brought frontal rain and snow that gave way mid-month, under a southerly air flow and high pressure over Europe, to a warm and dry period. Wintry conditions from the 1st to the 3rd prompted weather warnings for snow and ice in Scotland, Wales and eastern and southern England. There were widespread school closures and 33cm of snow was reported on the 2nd at Tomnavoulin (Morayshire). Changeable conditions from the 4th to the 12th included storm 'Erik' on the 8th/9th when surface water flooding was reported in Wales and maximum daily rainfall totals of 53mm and 35mm, respectively, were recorded at Shap (Cumbria). Dry weather thereafter, interrupted by westerly frontal bands of rain from 16th-20th, intensified into unseasonably warm conditions with little appreciable rainfall that dominated the rest of the month. February rainfall was below average across most of the UK, and for the country as a whole was 84% of the long term average. The North East Scotland, Yorkshire and Forth regions received the lowest rainfall (60%, 66% and 69% of average, respectively), whilst in parts of western Scotland and the south and north west of England, rainfall was average or above. Following a dry January, two month rainfall accumulations were no more than 70% of average in every region except the Highlands making it the driest onset to a calendar year since 2006 for the UK as a whole (66% of average) - and for Northumbria (46%) and Tweed (44%) the third and fourth driest, respectively, since 1910. Over the longer term, nine-month accumulations (June 2018 - February 2019) were no more than 75% of average in Yorkshire, Severn-Trent, Anglian and Thames regions.

### River flows
River flows increased in response to the wintry, unsettled and stormy conditions during the first ten days of the month and then receded, with some interruptions - most significantly in the west. Following a dry January, flows were low at the start of February and new daily minima were recorded on the 1st and 2nd on the Scottish Tyne, Whiteadder, Tweed and Coquet. Sharp rises followed in response to rainfall, exacerbated by snowmelt, and then storm 'Erik' on the 8th/9th. In Northern Ireland, the storm brought reports of flooding in Londonderry, the second highest February peak flow recorded on the Faughan and third highest on the Mourne (in series from 1977 and 1983, respectively). There were 22 Flood Warnings on the 8th in England and Scotland, and Flood Alerts in England continued for several days. Wet weather from the 16th to the 20th brought further flow responses, most notably in south west Scotland, Cumbria and north Wales. Elsewhere, recessions were sustained for the remainder of the month, the Scottish Tyne once again recording new daily minima for ten consecutive days from 18th-27th. Monthly mean flows were in the normal range across much of the UK, and above normal in Cumbria. In central and eastern England however, river flows were below normal, with many recording around half of their average flow, reflecting long term rainfall deficits and reduced baseflow contributions. Moreover, high rainfall deficits in the Scottish Borders and north east England resulted in notably or exceptionally low river flows, with the Scottish Tyne and Tweed recording around a quarter of average. For January and February together, river flows were below normal or notably low across Northern Ireland, Wales and much of England. On the east coast, however, flows were exceptionally low from the Scottish to the English Tyne, with both the Scottish Tyne and the Coquet experiencing the lowest average flows for this period in series from 1965 and 1964, respectively. The average outflows for Great Britain for January and February were the fifth lowest in a series from 1961.

### Groundwater
Groundwater levels at most of the Chalk boreholes rose during February, but Aylesby, Dial Farm and Therfield Rectory had yet to record any recharge. Levels at most sites were below normal to notably low, although many boreholes across southern coastal counties remained in the normal range, despite receding at the end of the month. In the more rapidly responding Jurassic limestones, levels rose overall (but fell in the second half of the month at Ampney Crucis); levels remained below normal at New Red Lion. Levels continued to fall in the Magnesian limestones, and at month-end were below normal. The level in the Upper Greensand at Lime Kiln Way rose slowly but ended the month below normal. In the Permo-Triassic sandstones, levels fell in the Midlands and north Wales and were stable at Bussells 7a and Newbridge. Despite rising at Skirwith levels were below normal as they were at Llanfair DC, but were close to normal elsewhere. In the Carboniferous Limestone of south Wales, levels rose in the first half of the month, but receded subsequently, and ended the month below average. At Alstonfield levels rose, recovering from notably low to below normal. At Royalty Observatory, levels continued to fall slowly and ended the month below normal.

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# Rainfall . . . Rainfall . . .

Met Office

## Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

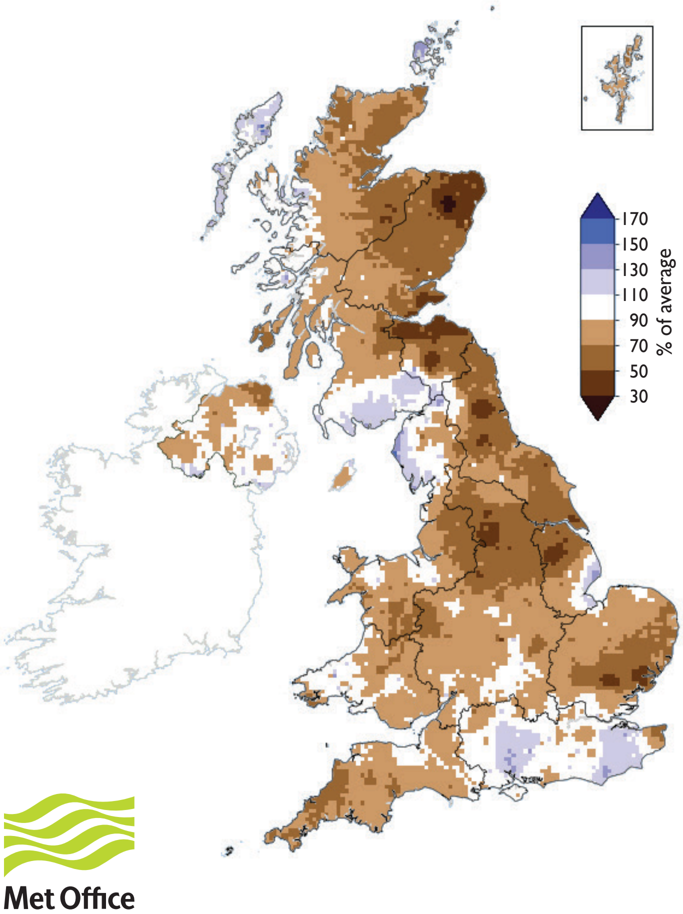
| Region | Rainfall | Feb 2019 | Jan19 – Feb19 | | Dec18 – Feb19 | | Jun18 – Feb19 | | Mar18 – Feb19 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *RP* | | *RP* | | *RP* | | *RP* |
| United | mm | **73** | 136 | | 256 | | 763 | | 1002 | |
| Kingdom | % | **84** | 66 | 5-10 | 78 | 2-5 | 85 | 5-10 | 89 | 2-5 |
| England | mm | **49** | 86 | | 186 | | 521 | | 751 | |
| | % | **82** | 61 | 10-15 | 81 | 2-5 | 78 | 10-15 | 89 | 2-5 |
| Scotland | mm | **107** | 209 | | 341 | | 1099 | | 1330 | |
| | % | **84** | 69 | 2-5 | 73 | 2-5 | 90 | 2-5 | 88 | 2-5 |
| Wales | mm | **93** | 181 | | 383 | | 1017 | | 1353 | |
| | % | **86** | 70 | 5-10 | 90 | 2-5 | 89 | 2-5 | 95 | 2-5 |
| Northern | mm | **76** | 128 | | 237 | | 741 | | 966 | |
| Ireland | % | **91** | 64 | 10-15 | 75 | 5-10 | 83 | 10-20 | 85 | 8-12 |
| England & | mm | **55** | 99 | | 213 | | 590 | | 834 | |
| Wales | % | **83** | 63 | 8-12 | 84 | 2-5 | 81 | 8-12 | 90 | 2-5 |
| North West | mm | **79** | 147 | | 289 | | 841 | | 1045 | |
| | % | **89** | 69 | 5-10 | 83 | 2-5 | 85 | 5-10 | 85 | 5-10 |
| Northumbria | mm | **45** | 67 | | 129 | | 536 | | 744 | |
| | % | **70** | 46 | 30-50 | 55 | 15-25 | 78 | 10-20 | 85 | 5-10 |
| Severn-Trent | mm | **39** | 72 | | 166 | | 446 | | 694 | |
| | % | **75** | 58 | 10-20 | 83 | 2-5 | 73 | 15-25 | 89 | 2-5 |
| Yorkshire | mm | **40** | 72 | | 167 | | 498 | | 730 | |
| | % | **66** | 50 | 20-30 | 73 | 5-10 | 75 | 15-25 | 86 | 5-10 |
| Anglian | mm | **29** | 53 | | 120 | | 344 | | 532 | |
| | % | **75** | 57 | 10-20 | 82 | 2-5 | 71 | 15-25 | 85 | 5-10 |
| Thames | mm | **45** | 76 | | 155 | | 418 | | 643 | |
| | % | **93** | 65 | 5-10 | 83 | 2-5 | 75 | 10-15 | 89 | 2-5 |
| Southern | mm | **60** | 93 | | 201 | | 532 | | 772 | |
| | % | **106** | 67 | 5-10 | 89 | 2-5 | 84 | 2-5 | 96 | 2-5 |
| Wessex | mm | **59** | 101 | | 229 | | 560 | | 821 | |
| | % | **92** | 65 | 5-10 | 90 | 2-5 | 80 | 5-10 | 93 | 2-5 |
| South West | mm | **75** | 148 | | 333 | | 836 | | 1158 | |
| | % | **75** | 63 | 5-10 | 87 | 2-5 | 85 | 2-5 | 94 | 2-5 |
| Welsh | mm | **90** | 175 | | 366 | | 977 | | 1308 | |
| | % | **88** | 70 | 5-10 | 91 | 2-5 | 89 | 2-5 | 96 | 2-5 |
| Highland | mm | **135** | 300 | | 444 | | 1325 | | 1540 | |
| | % | **82** | 79 | 2-5 | 76 | 2-5 | 91 | 2-5 | 85 | 2-5 |
| North East | mm | **45** | 108 | | 180 | | 666 | | 860 | |
| | % | **60** | 62 | 8-12 | 67 | 10-20 | 83 | 5-10 | 85 | 8-12 |
| Tay | mm | **83** | 127 | | 239 | | 919 | | 1167 | |
| | % | **75** | 47 | 10-20 | 58 | 10-20 | 86 | 2-5 | 87 | 2-5 |
| Forth | mm | **66** | 99 | | 189 | | 755 | | 984 | |
| | % | **69** | 42 | 15-25 | 53 | 15-25 | 78 | 5-10 | 82 | 5-10 |
| Tweed | mm | **57** | 80 | | 156 | | 681 | | 919 | |
| | % | **74** | 44 | 25-40 | 54 | 15-25 | 83 | 5-10 | 90 | 2-5 |
| Solway | mm | **122** | 191 | | 357 | | 1142 | | 1395 | |
| | % | **108** | 70 | 2-5 | 82 | 2-5 | 96 | 2-5 | 94 | 2-5 |
| Clyde | mm | **130** | 234 | | 405 | | 1349 | | 1622 | |
| | % | **87** | 65 | 2-5 | 73 | 2-5 | 92 | 2-5 | 89 | 2-5 |

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

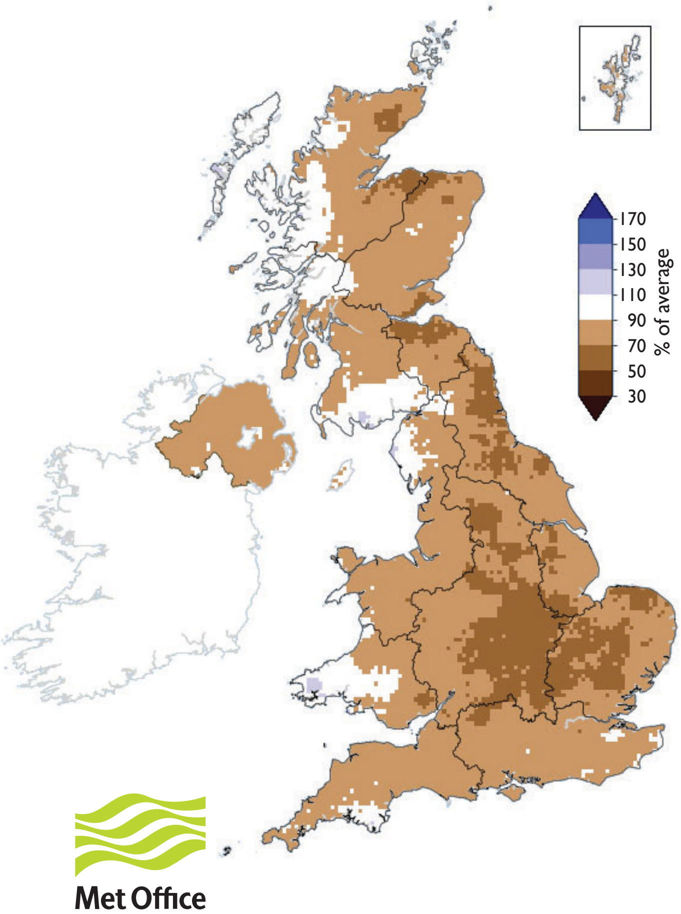
**Important note:** Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect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

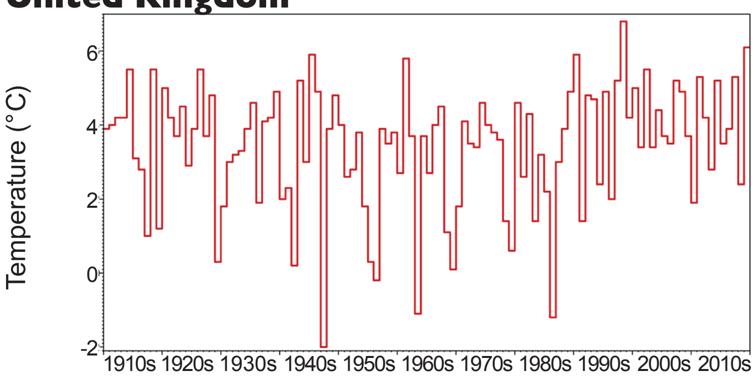
**February 2019 rainfall as % of 1981-2010 average**



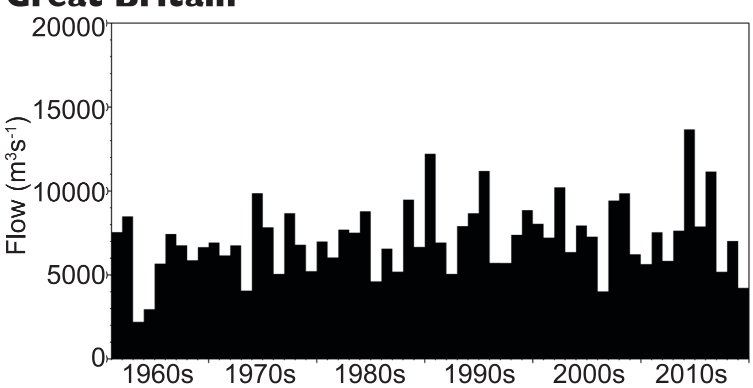

**June 2018 - February 2019 rainfall as % of 1981-2010 average**




## February average temperatures for the United Kingdom




## Average January-February outflows for Great Britain




## 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.

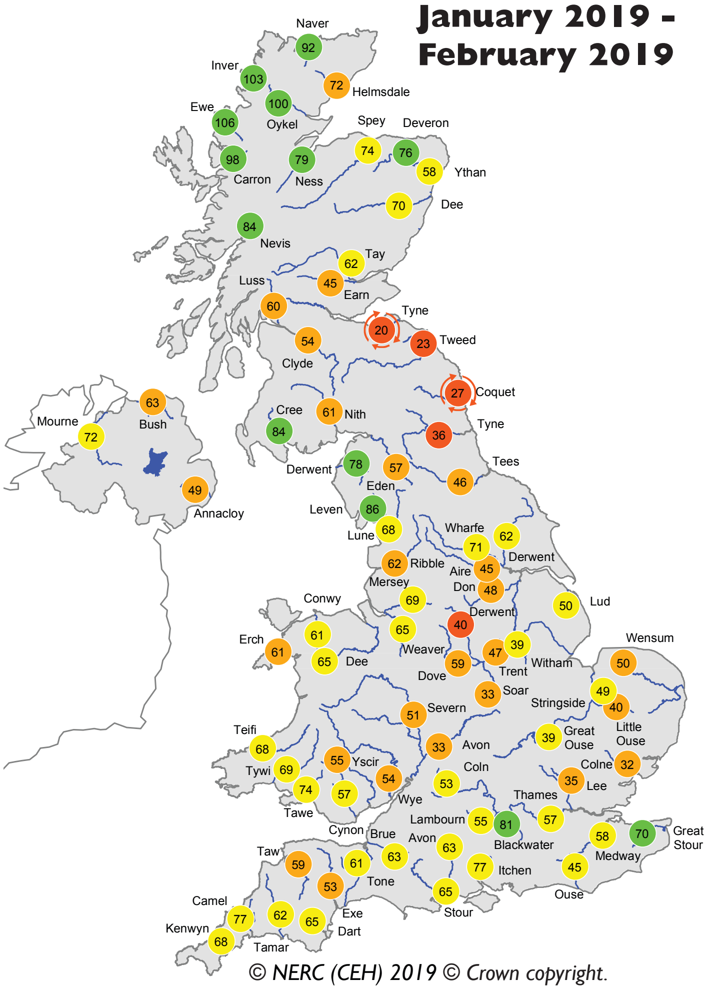
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

**Period:** **from March 2019**
**Issued:** **08.03.2019**
**using data to the end of February 2019**

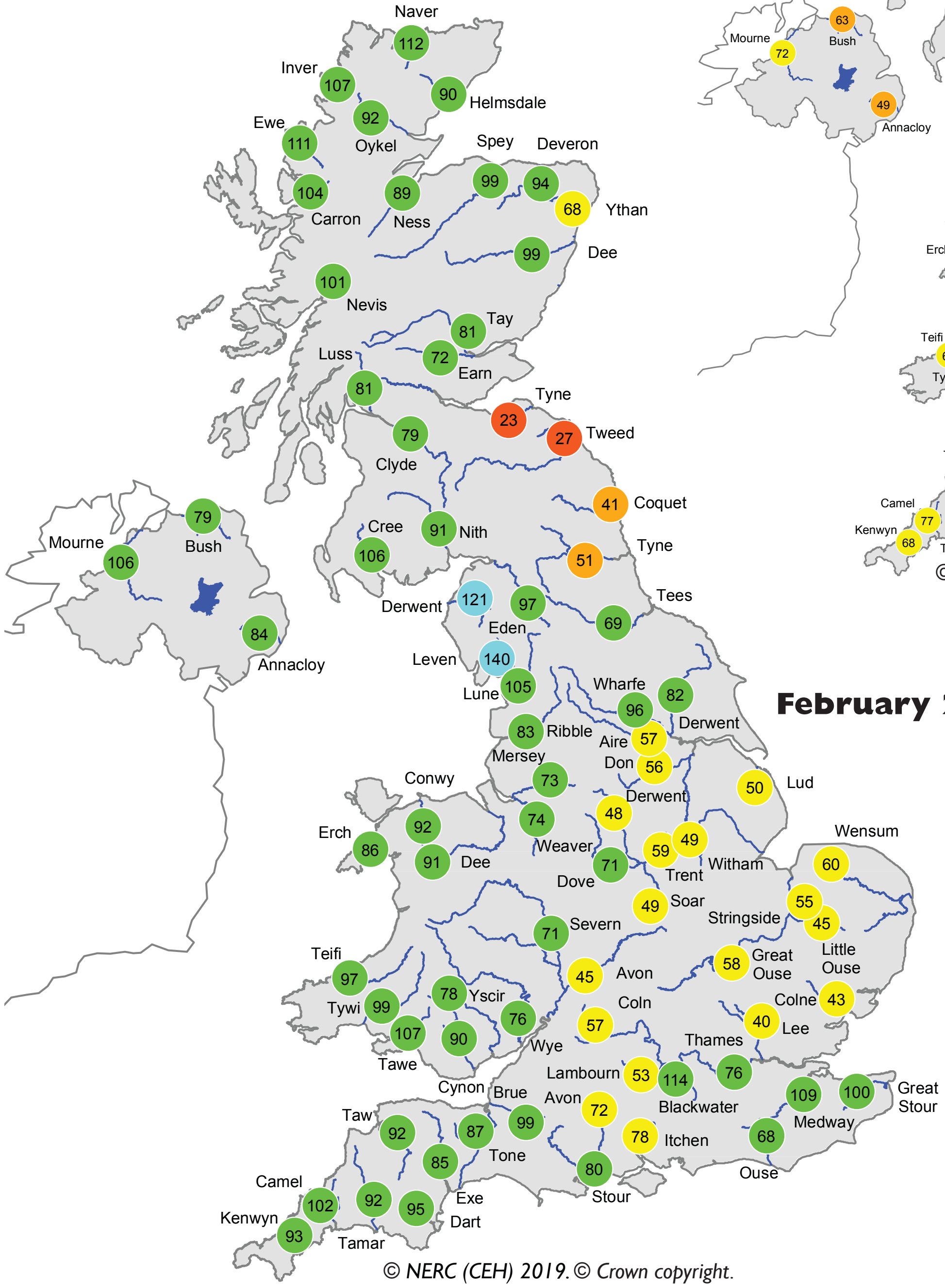
Below normal river flows and groundwater levels in parts of central and eastern England are likely to persist through the spring (March-May). For the rest of the UK, March river flows are likely to be in the normal range, except in north-eastern Britain where flows are likely to be normal to below normal, and the three-month outlook is similar. Groundwater levels across the majority of the UK are likely to be normal to below normal through the spring (March-May).

# River flow . . . River flow . . .

## January 2019 - February 2019




## February 2019




### Key

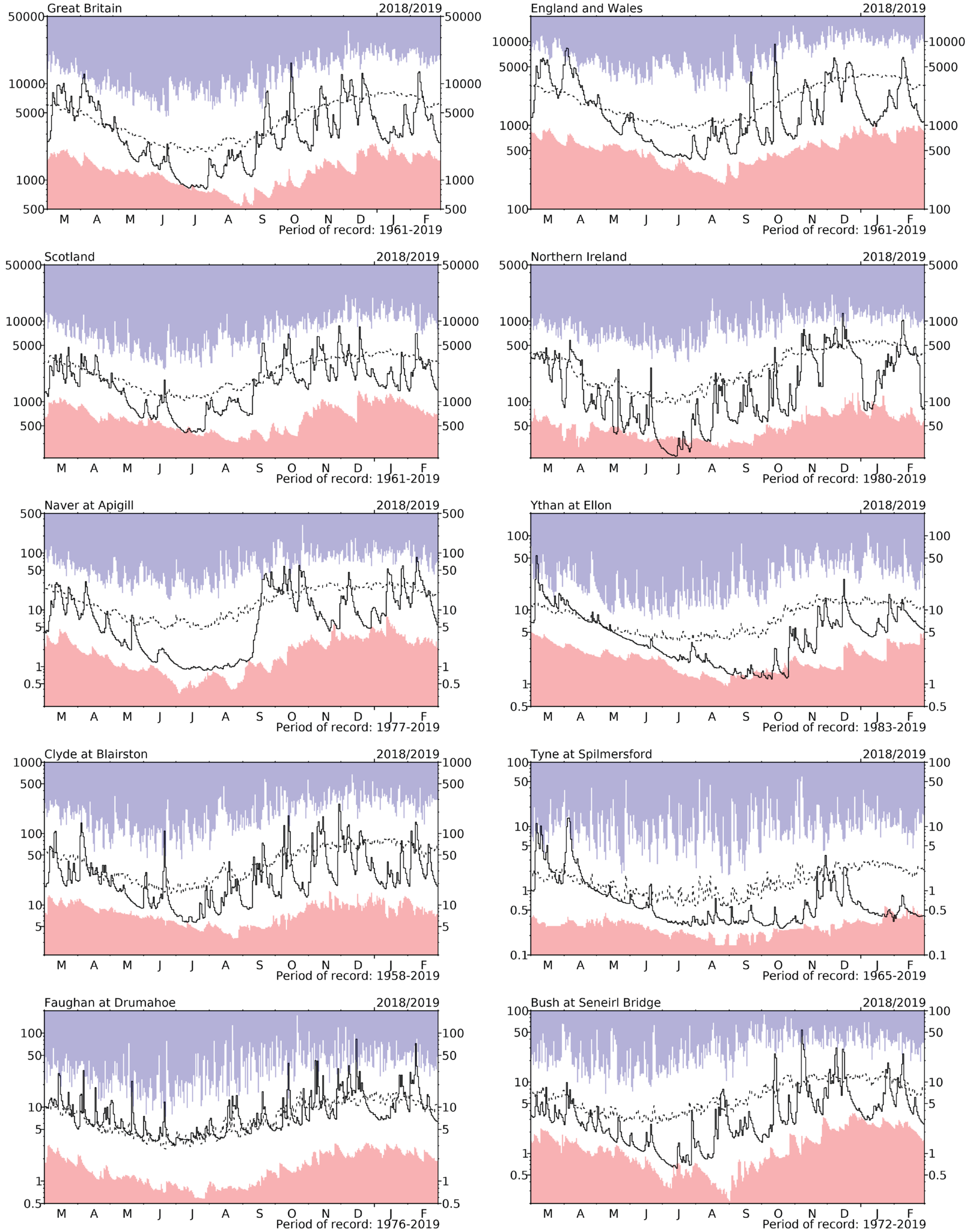
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*Based on ranking of the monthly flow**

## River flows

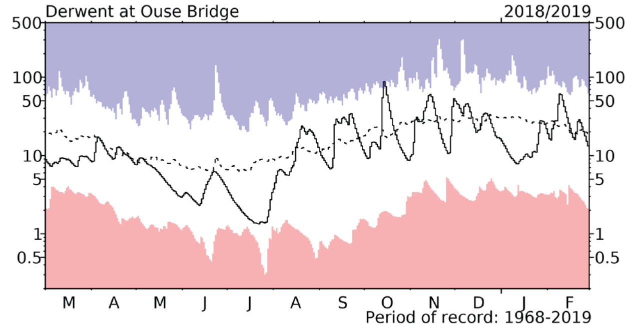
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

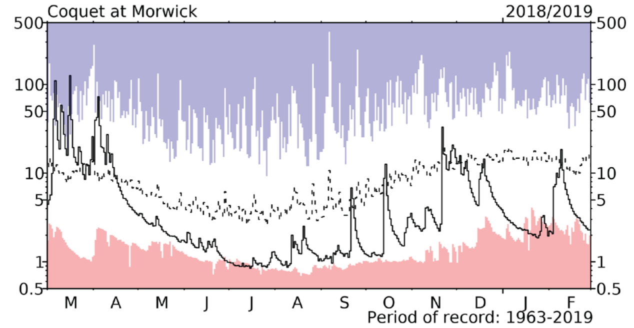
# River flow . . . River flow . . .

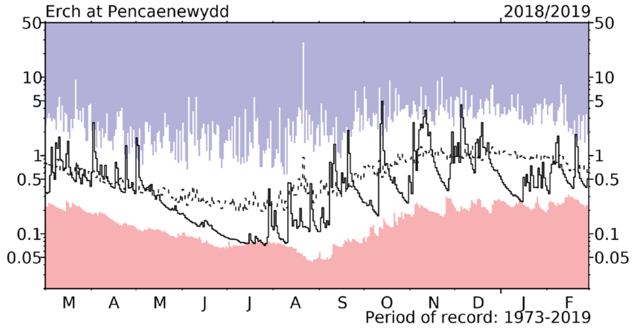


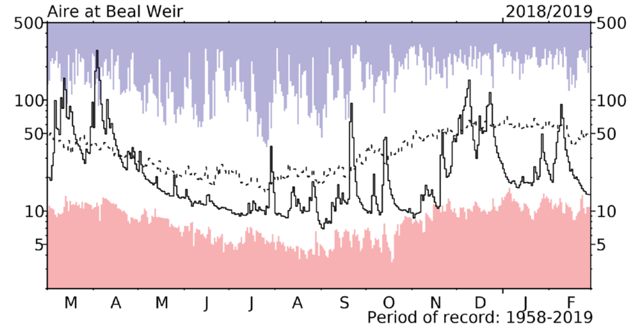

## River flow hydrographs

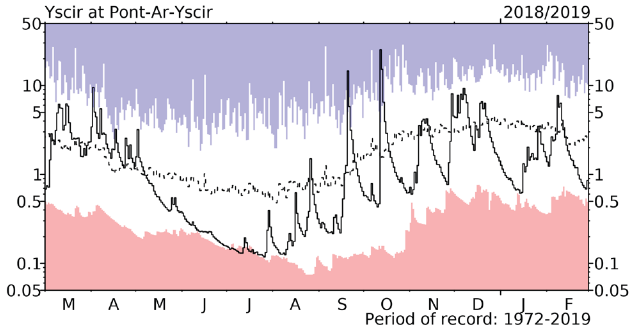
*The river flow hydrographs show the daily mean flows (measured in $m^3s^{-1}$) together with the maximum and minimum daily flows prior to February 2018 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

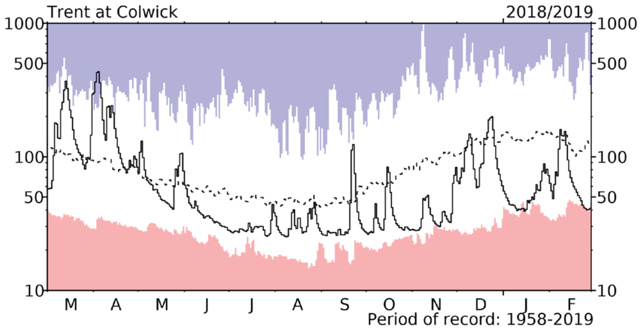

Derwent at Ouse Bridge
2018/2019
Period of record: 1968-2019

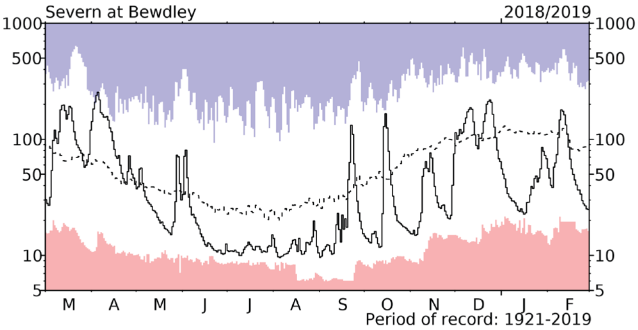

Coquet at Morwick
2018/2019
Period of record: 1963-2019

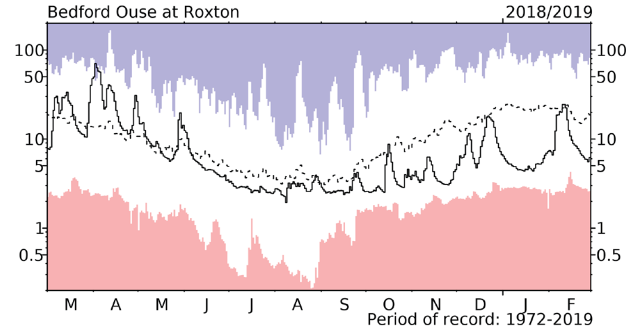

Erch at Pencaenewydd
2018/2019
Period of record: 1973-2019

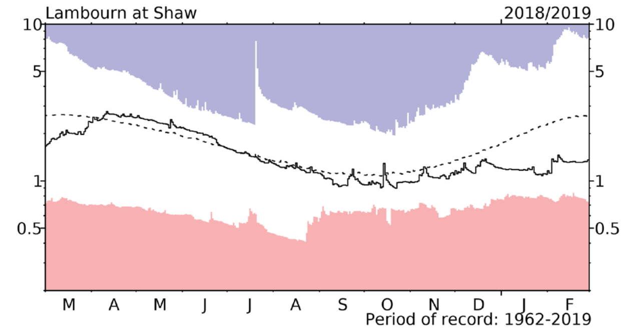

Aire at Beal Weir
2018/2019
Period of record: 1958-2019

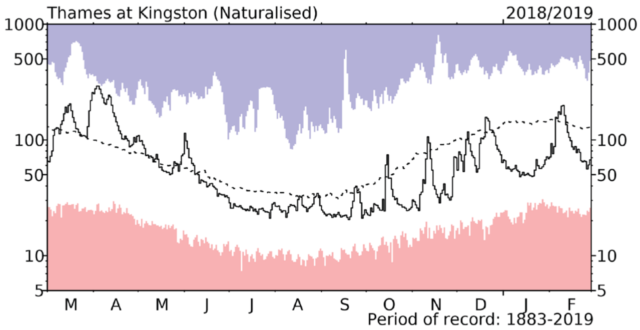

Yscir at Pont-Ar-Yscir
2018/2019
Period of record: 1972-2019

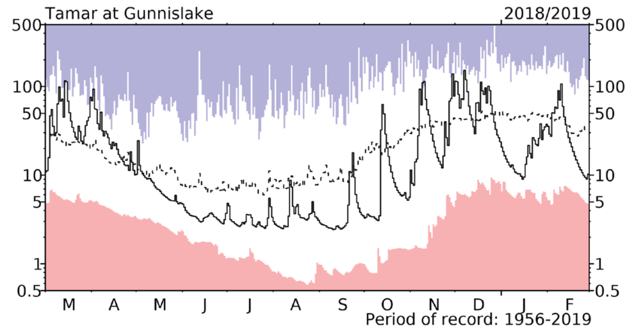

Trent at Colwick
2018/2019
Period of record: 1958-2019

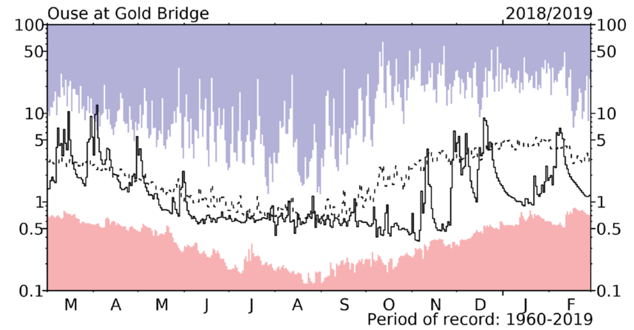

Severn at Bewdley
2018/2019
Period of record: 1921-2019


Bedford Ouse at Roxton
2018/2019
Period of record: 1972-2019

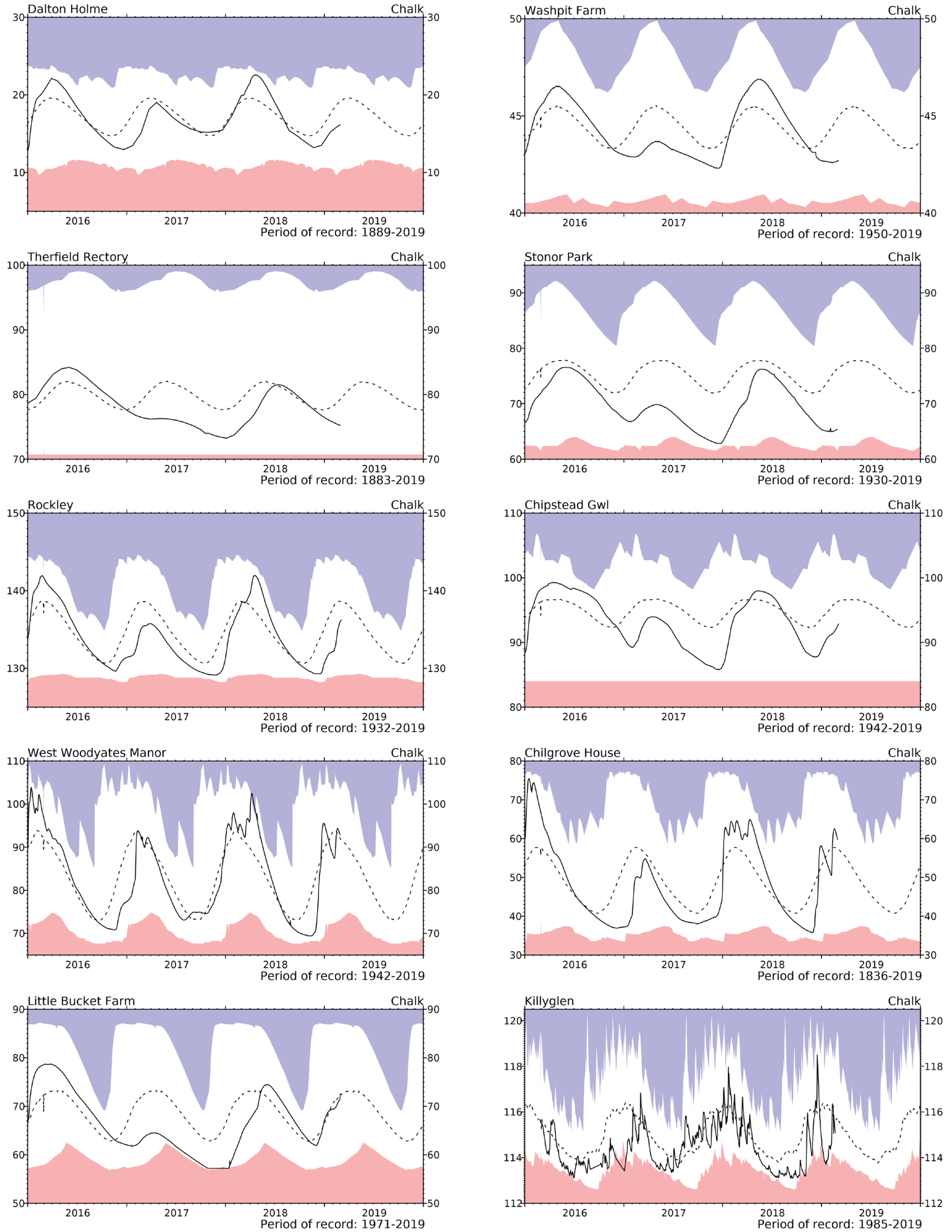

Lambourn at Shaw
2018/2019
Period of record: 1962-2019


Thames at Kingston (Naturalised)
2018/2019
Period of record: 1883-2019


Tamar at Gunnislake
2018/2019
Period of record: 1956-2019

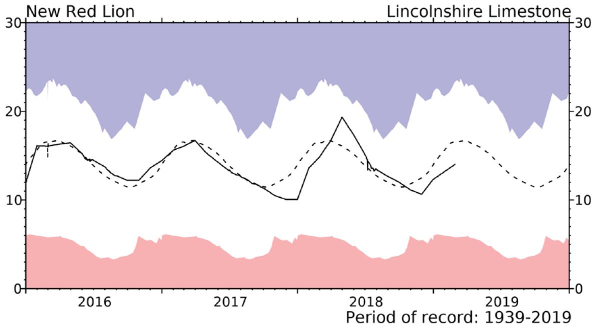

Ouse at Gold Bridge
2018/2019
Period of record: 1960-2019

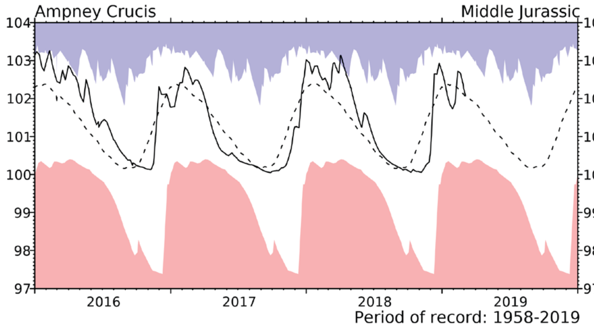
# Groundwater . . . Groundwater

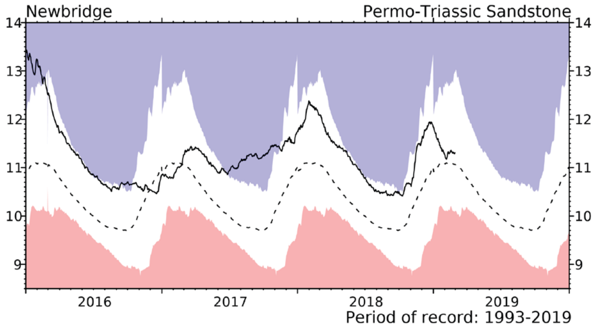


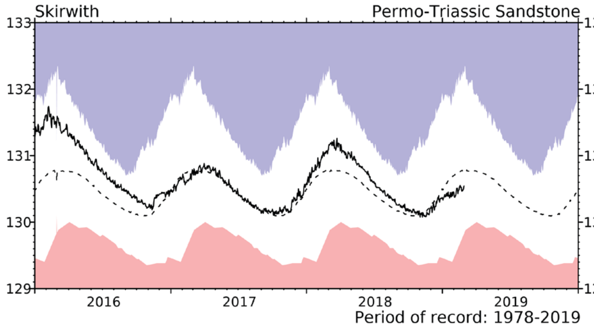

Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

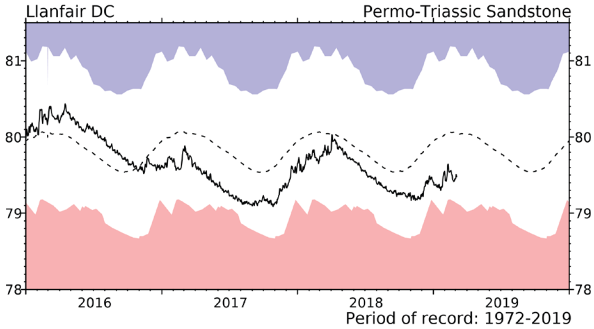
# *Groundwater... Groundwater*

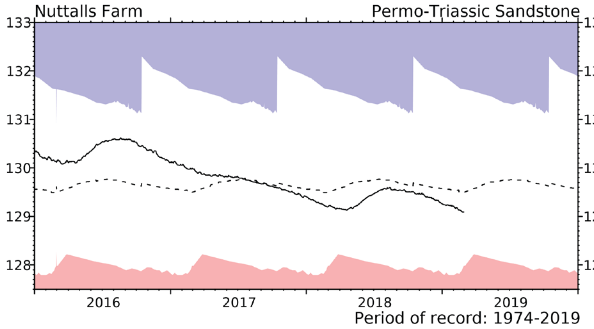


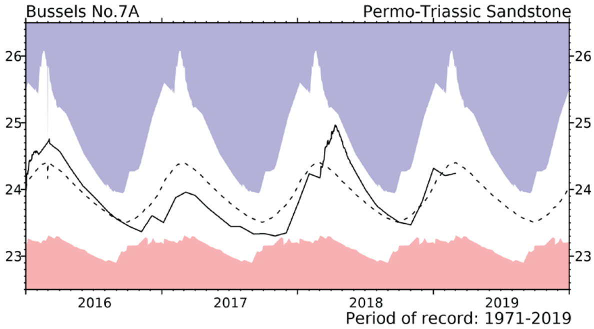



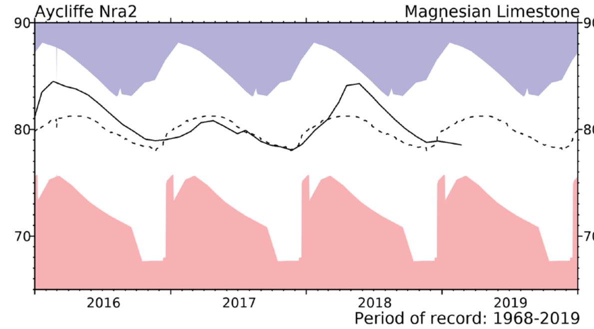



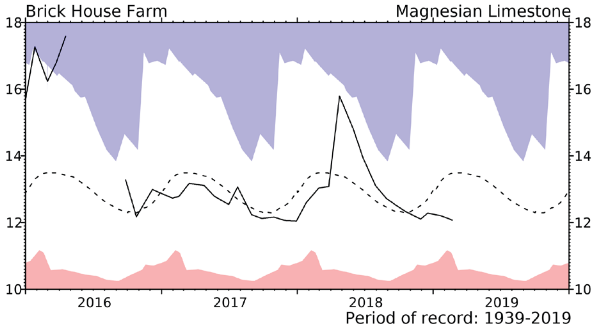



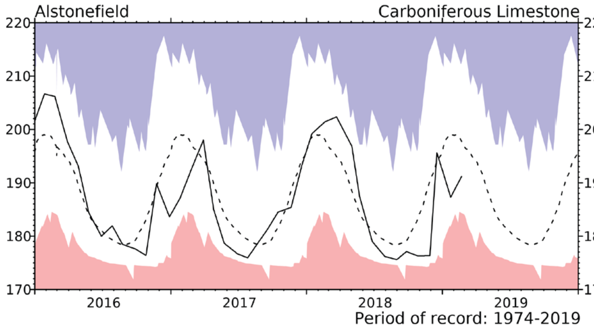



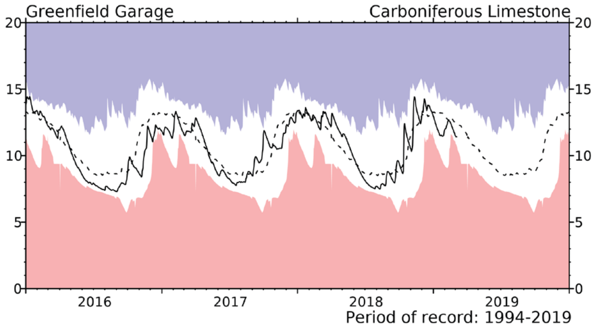



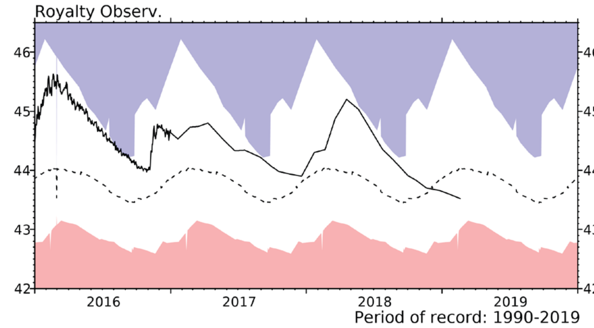



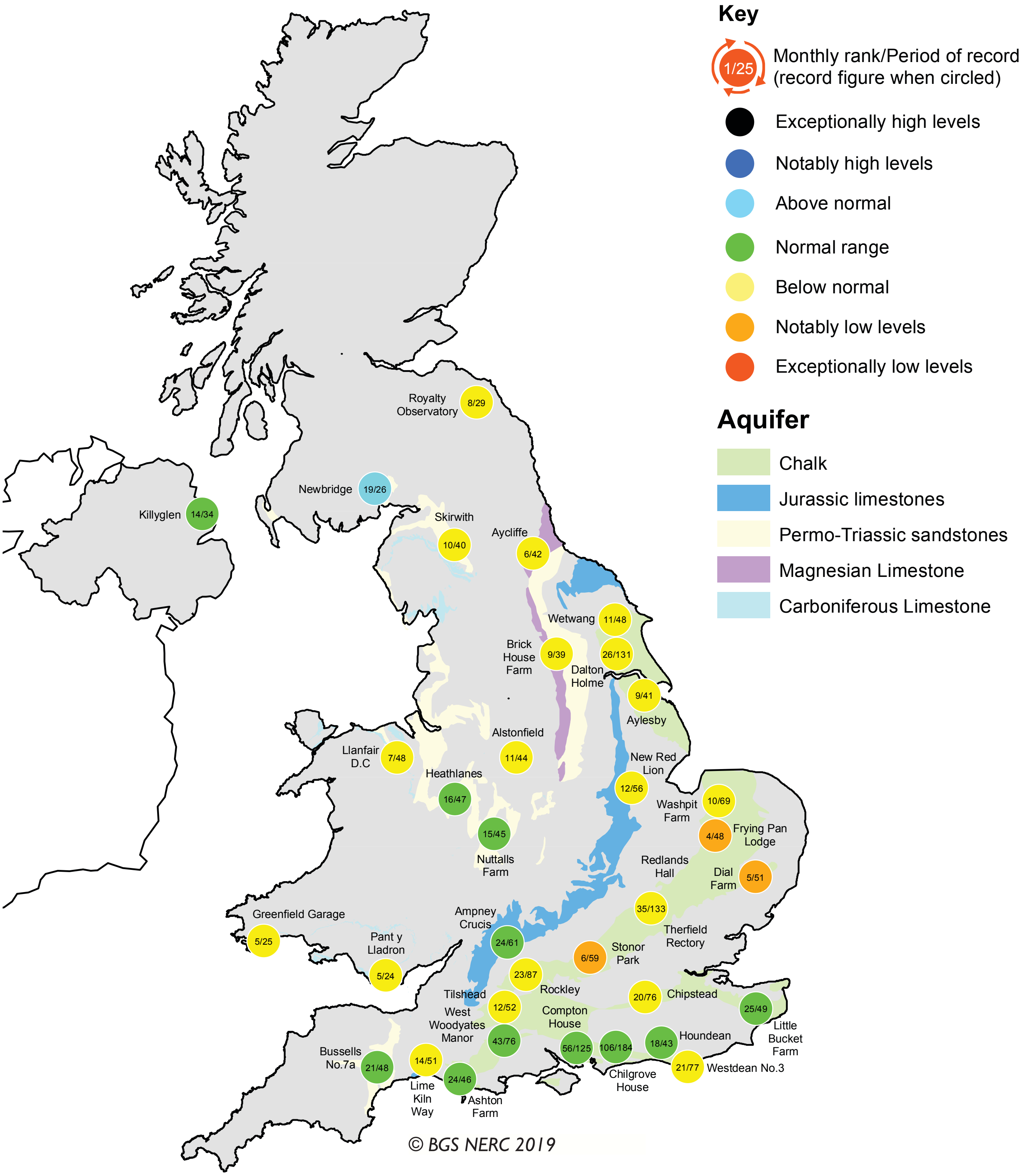



# Groundwater...Groundwater

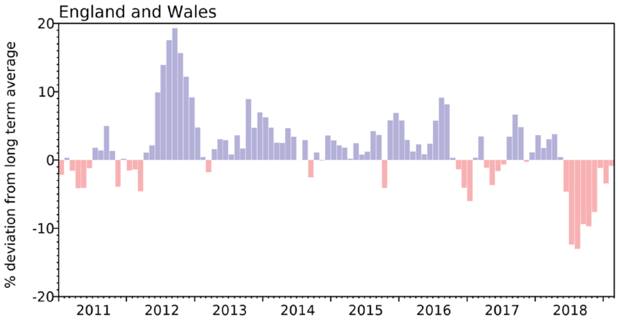



## Groundwater levels - February 2019

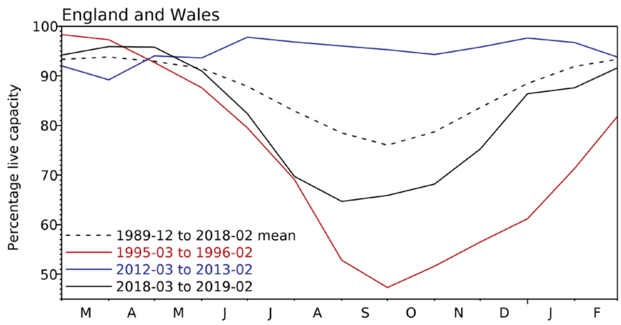
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

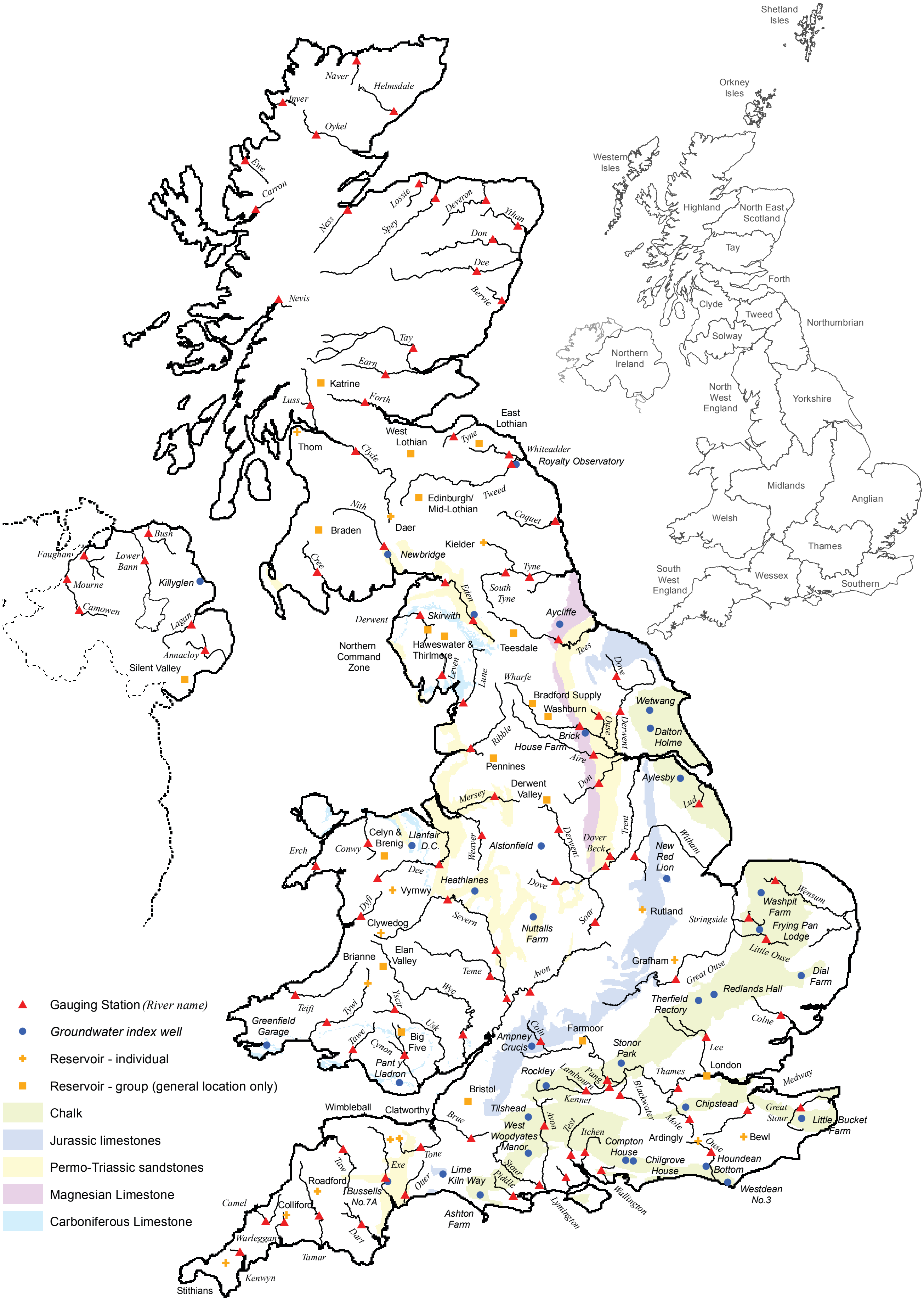
| Area | Reservoir | | Capacity (Ml) | 2018 Dec | 2019 Jan | 2019 Feb | Feb Anom. | Min Feb | Year* of min | 2018 Feb | Diff 19-18 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| North West | N Command Zone | • | 124929 | 90 | 84 | 93 | 0 | 78 | 1996 | 86 | 6 |
| | Vyrnwy | | 55146 | 88 | 89 | 98 | 4 | 59 | 1996 | 96 | 3 |
| Northumbrian | Teesdale | • | 87936 | 99 | 98 | 98 | 6 | 72 | 1996 | 97 | 1 |
| | Kielder | | (199175) | 84 | 82 | 89 | -3 | 81 | 1993 | 90 | -1 |
| Severn-Trent | Clywedog | | 49936 | 87 | 94 | 95 | 4 | 77 | 1996 | 94 | 1 |
| | Derwent Valley | • | 46692 | 74 | 78 | 83 | -13 | 46 | 1996 | 91 | -8 |
| Yorkshire | Washburn | • | 23373 | 96 | 87 | 95 | 1 | 53 | 1996 | 96 | -2 |
| | Bradford Supply | • | 40942 | 76 | 74 | 78 | -17 | 53 | 1996 | 99 | -21 |
| Anglian | Grafham | | (55490) | 66 | 72 | 78 | -11 | 72 | 1997 | 96 | -18 |
| | Rutland | | (116580) | 82 | 82 | 90 | 1 | 71 | 2012 | 93 | -3 |
| Thames | London | • | 202828 | 87 | 94 | 92 | -1 | 83 | 1988 | 95 | -3 |
| | Farmoor | • | 13822 | 88 | 97 | 93 | 0 | 64 | 1991 | 97 | -5 |
| Southern | Bewl | | 31000 | 89 | 95 | 98 | 12 | 40 | 2012 | 88 | 10 |
| | Ardingly | | 4685 | 70 | 75 | 95 | -1 | 46 | 2012 | 100 | -5 |
| Wessex | Clatworthy | | 5364 | 100 | 95 | 99 | 1 | 82 | 1992 | 100 | -1 |
| | Bristol | • | (38666) | 82 | 80 | 89 | -3 | 65 | 1992 | 98 | -9 |
| South West | Colliford | | 28540 | 74 | 78 | 83 | -4 | 57 | 1997 | 99 | -16 |
| | Roadford | | 34500 | 67 | 68 | 71 | -13 | 35 | 1996 | 90 | -19 |
| | Wimbleball | | 21320 | 77 | 83 | 97 | 2 | 72 | 1996 | 94 | 3 |
| | Stithians | | 4967 | 90 | 100 | 99 | 6 | 45 | 1992 | 100 | -1 |
| Welsh | Celyn & Brenig | • | 131155 | 87 | 89 | 94 | -4 | 69 | 1996 | 99 | -5 |
| | Brianne | | 62140 | 100 | 99 | 96 | -2 | 92 | 2004 | 98 | -2 |
| | Big Five | • | 69762 | 90 | 94 | 97 | 1 | 85 | 1988 | 94 | 3 |
| | Elan Valley | • | 99106 | 100 | 99 | 98 | 0 | 88 | 1993 | 98 | 0 |
| Scotland(E) | Edinburgh/Mid-Lothian | • | 96518 | 92 | 90 | 93 | -2 | 73 | 1999 | 97 | -4 |
| | East Lothian | • | 9374 | 95 | 98 | 98 | -1 | 91 | 1990 | 100 | -2 |
| Scotland(W) | Loch Katrine | • | 110326 | 96 | 95 | 100 | 5 | 76 | 2010 | 98 | 2 |
| | Daer | | 22494 | 98 | 96 | 100 | 1 | 94 | 2004 | 99 | 1 |
| | Loch Thom | | 10798 | 100 | 99 | 99 | 1 | 90 | 2004 | 100 | -1 |
| Northern Ireland | Total+ | • | 56800 | 95 | 93 | 95 | 4 | 81 | 2004 | 98 | -3 |
| | Silent Valley | • | 20634 | 99 | 95 | 98 | 10 | 57 | 2002 | 98 | 0 |

( ) 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.

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## 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