Hydrological Summary

for the United Kingdom

November 2012

General

Across much of the country the remarkable hydrological transformation since the severe drought conditions of the early spring was reinforced through November. Regional variations in rainfall have been large over the last eight months but for Britain as a whole the April-November rainfall is the highest in a series from 1910. The latter half of November was particularly unsettled, punctuated by periods of heavy and sustained frontal rainfall. With catchments close to saturation river flows responded rapidly and floodplain inundations were both frequent and extensive. Runoff from England & Wales was outstanding during the fourth week and, although very high concentrations of suspended solids restricted replenishment to some pumped storage reservoirs (e.g. Farmoor), overall reservoir stocks (for England & Wales) for early December were the 2nd highest on record (after 2000). Stocks in the great majority of index reservoirs across the UK are within 10% of capacity. Overall, groundwater resources are also exceptionally healthy although pockets of depressed groundwater levels remain in some of the slowest-responding aquifers – particularly in the Midlands. However, with catchments remaining close to saturation and the contribution of springs and seepages to river flows increasing, there is an enhanced risk of both fluvial and groundwater flooding through the early winter at least.

Rainfall

After a damp start to November, high pressure dominated synoptic patterns throughout much of the first half of the month with precipitation largely restricted to fog-drip in a few areas. On the 19th, however, the passage of a very vigorous frontal system heralded an exceptionally unsettled interlude: 8-day rainfall totals in many parts of England and Wales exceeded the November average with accumulated totals >180mm in Snowdonia and Dartmoor; the Lake District was also very wet, with Blencathra recording 67mm on the 26th. Local flash flooding was common (e.g. in western Scotland) and landslips disrupted a number of important transport links (e.g. the A83). This very wet episode ensured that November rainfall totals were well above average in a broad swathe from Northumbria through the Midlands to south Devon. By contrast, much of northeast Scotland was relatively dry and Northern Ireland reported its 2nd driest November in the last 20 years. Nonetheless, for many parts of the country November was the 6th successive month with above average rainfall and rainfall accumulations since April are outstanding over wide areas. For England, the April-November rainfall exceeded the previous maximum in a series from 1910 and historical rainfall data for England & Wales suggest that it was the wettest such 8-month sequence since at least 1766 (see page 3).

River flows

Following minor spates in early November, recessions characterised most responsive rivers and some notably low flows were reported in mid-month; in eastern Scotland the River Bervie closely approached its November minimum on the 17th. Subsequently, river flows picked-up sharply heralding exceptional runoff rates and very widespread floodplain inundations which continued into early December. Following notable flooding in Scotland on the 19th (e.g. at Comrie and Dunblane) river basins across much of the country were subject to significant floodplain inundations. In England and Wales, there were Flood Alerts in all regions by the 26th when, very exceptionally, nearly 300 Flood Warnings were also in operation. Instances of substantial flooding were common and widely distributed e.g. Northallerton (North Yorkshire), Malmesbury (Wilts.), Kennford (Devon) and, with the rain continuing, two modern estates (at St. Asaph and Ruthin) were inundated in North Wales. Across the country, extensive areas of agricultural land were flooded and, with leaves and other debris hindering drainage, flash flooding incidents were also common. Some outstanding river flows were reported: in Yorkshire, the Derwent registered its 3rd highest flow in 39 years; the Coln (Cotswolds) exceeded its previous November maximum flow; and runoff in many rivers draining the Midlands were exceptional – in Warwickshire, the Avon exceeded its previous November maximum in a series from 1937. With most rivers in high spate, total outflows from England & Wales exceeded previous daily maxima during late November, adding to the seasonally remarkable runoff since the early spring. April-November outflows exceeded previous maxima in many index catchments and established a new maximum for England & Wales in a series from 1961.

Groundwater

Following the remarkable late spring and summer recharge, the normal seasonal recoveries in responsive aquifer units began from exceptionally high levels and, generally, gathered further momentum during November. In the major Chalk outcrops levels remain below average only in the slower-responding aquifer units in the Chilterns and parts of East Anglia. In Wessex and Sussex, levels rose by around 10m at Chilgrove, Compton and Tilshead and, benefiting from exceptional November infiltration, exceeded previous monthly maxima at Ashton Farm and West Woodyates. Such high levels early in the winter imply a considerably enhanced risk of localised groundwater flooding occurring later in the recharge season; levels in parts of both the South West (e.g. south Dorset) and South East (Hampshire and Berkshire) regions having risen above flood alert trigger levels. In the Permo-Triassic sandstones, record monthly maxima were recorded in the North West and South West, at Skirwith and Bussels. In contrast, in North Wales and the Midlands, levels remained average or below, with Weeford Flats still dry, although Heathlanes has started its recovery. In the limestone aquifers, levels remain above the previous monthly maximum at Swan House (Magnesian) and close to previous maxima in the Jurassic Limestones (Ampney Crucis). The generally very healthy groundwater resources are reflected in exceptional spring outflows (and a corresponding extension of the stream network).

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

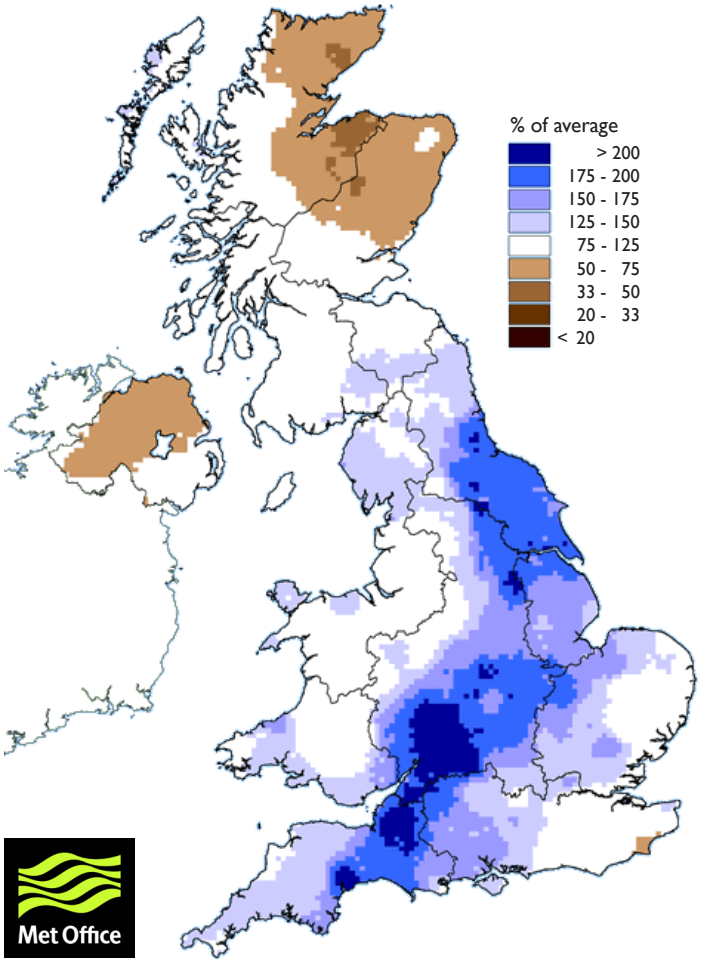
Area	Rainfall	Nov 2012	Sep12 — Nov12	RP	Apr12 — Nov12	RP	Aug11 — Nov12	RP	Feb11 — Nov12	RP
United Kingdom	mm	**134**	374		940		1754		2218	
	%	**117**	116	2-5	140	>100	118	30-50	115	20-35
England	mm	**120**	317		845		1313		1600	
	%	**148**	135	8-12	161	>>100	117	5-10	109	2-5
Scotland	mm	**154**	457		1051		2406		3149	
	%	**97**	102	2-5	122	10-15	121	60-90	123	>100
Wales	mm	**180**	470		1201		2074		2564	
	%	**117**	112	2-5	144	70-100	110	2-5	106	2-5
Northern Ireland	mm	**79**	301		804		1710		2218	
	%	**71**	94	2-5	116	5-10	112	10-15	112	20-30
England & Wales	mm	**129**	338		894		1418		1733	
	%	**141**	130	5-10	158	>>100	116	5-10	108	2-5
North West	mm	**155**	486		1150		2085		2625	
	%	**124**	137	10-15	156	>100	128	40-60	125	40-60
Northumbria	mm	**125**	371		998		1496		1885	
	%	**150**	162	20-35	187	>>100	132	>100	126	50-80
Midlands	mm	**110**	264		776		1148		1391	
	%	**155**	127	5-10	158	>100	111	2-5	102	2-5
Yorkshire	mm	**130**	337		896		1381		1683	
	%	**165**	150	10-20	173	>>100	125	15-25	115	5-10
Anglian	mm	**83**	208		625		913		1105	
	%	**147**	123	2-5	152	>100	111	2-5	101	2-5
Thames	mm	**101**	262		726		1065		1286	
	%	**152**	131	5-10	158	>100	112	2-5	102	2-5
Southern	mm	**95**	302		750		1145		1379	
	%	**114**	124	2-5	150	50-80	106	2-5	99	2-5
Wessex	mm	**158**	365		933		1399		1669	
	%	**183**	145	8-12	174	>>100	118	5-10	109	2-5
South West	mm	**192**	450		1126		1855		2204	
	%	**144**	126	5-10	158	>100	113	5-10	104	2-5
Welsh	mm	**177**	458		1174		2003		2469	
	%	**121**	114	2-5	146	>100	110	2-5	105	2-5
Highland	mm	**176**	514		1026		2726		3567	
	%	**87**	95	2-5	102	2-5	115	15-25	118	25-40
North East	mm	**65**	257		809		1507		2003	
	%	**65**	89	2-5	131	8-12	115	2-5	117	5-10
Tay	mm	**114**	360		1002		2074		2814	
	%	**87**	95	2-5	135	15-25	120	15-25	126	>100
Forth	mm	**124**	389		1076		2034		2692	
	%	**108**	115	2-5	156	>100	131	>100	134	>>100
Tweed	mm	**123**	397		1114		1863		2396	
	%	**131**	147	10-20	186	>>100	144	>>100	141	>100
Solway	mm	**179**	528		1264		2549		3316	
	%	**120**	123	5-10	148	>100	131	>>100	133	>>100
Clyde	mm	**209**	588		1264		3090		3986	
	%	**112**	109	2-5	122	8-12	129	>100	130	>100

% = percentage of 1971-2000 average *RP = Return period*

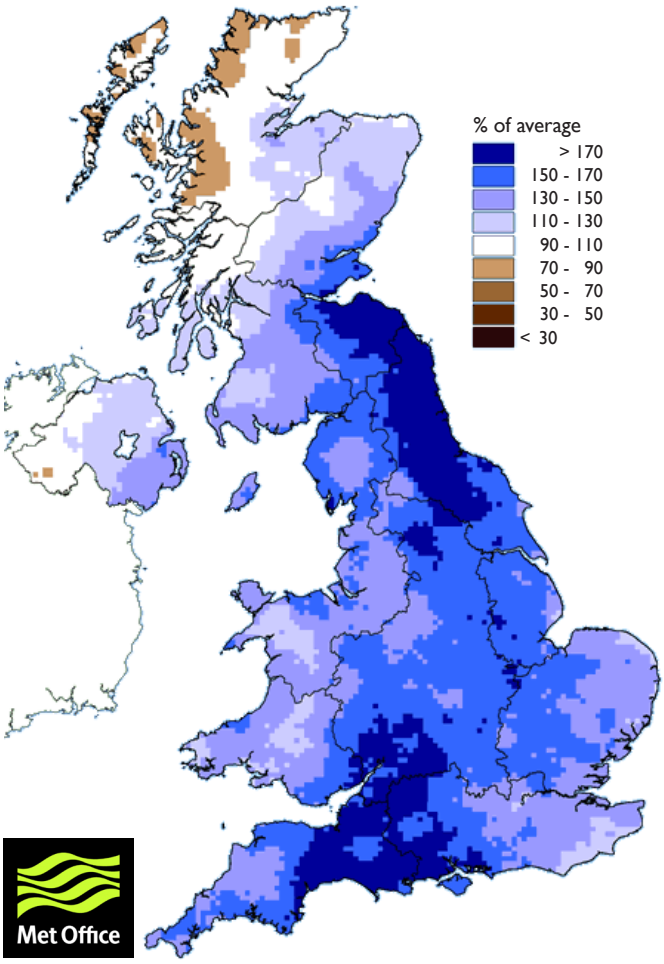
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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. All monthly rainfall totals since May 2012 are provisional.

Rainfall . . . Rainfall . . .

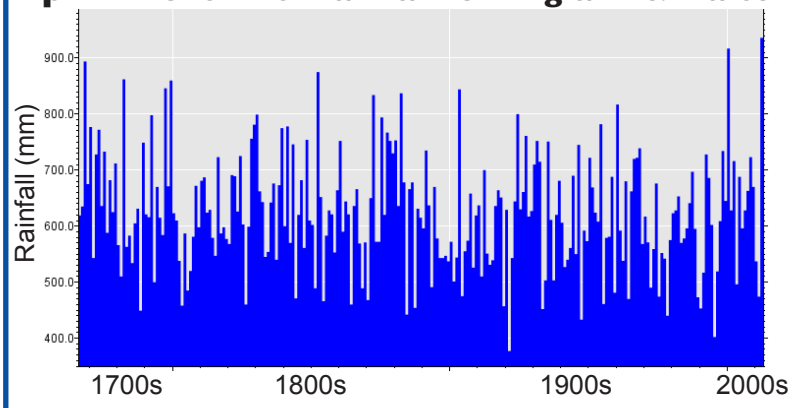
November 2012 rainfall as % of 1971-2000 average



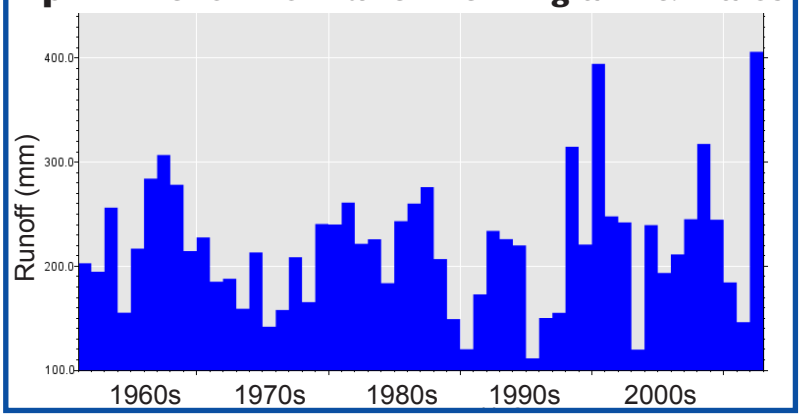
April 2012 - November 2012 rainfall as % of 1971-2000 average



April - November rainfall for England & Wales



April - November runoff for England & Wales



Met Office 3-month outlook Updated: December 2012

Predictions for UK-mean precipitation for December and December-January-February show a slight shift towards below-normal values – consistent with negative North Atlantic Oscillation conditions – although the spread of probabilities is large. Consequently, for the season as a whole the chance of above-average totals remains significant.

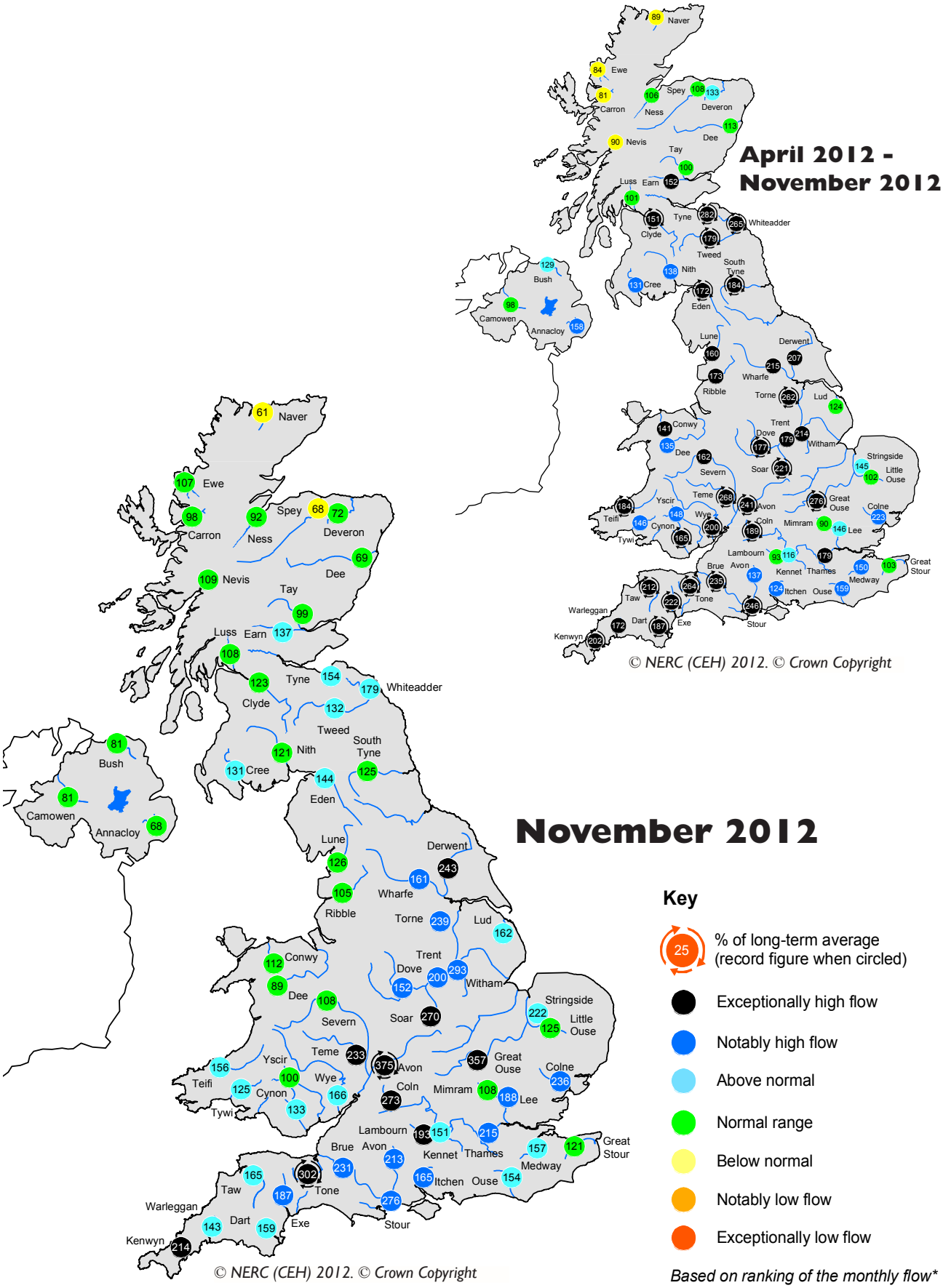
The probability that UK precipitation for December-January-February will fall into the driest of our five categories is between 20% and 25% and the probability that it will fall into the wettest category is around 15% (the climatological probability for each of these categories is 20%).

The risk of snowfall over the UK is related to the occurrence of cold winter weather. As probabilities favour for this year a colder season than last year's, the risk of snowfall is enhanced.

The complete version of the 3-month outlook may be found at:
http://www.metoffice.gov.uk/publicsector/contingency-planners
This outlook is updated towards the end of each calendar month.

The latest shorter-range forecasts, covering the upcoming 30 days, can be accessed via:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_weather.html
These forecasts are updated very frequently.

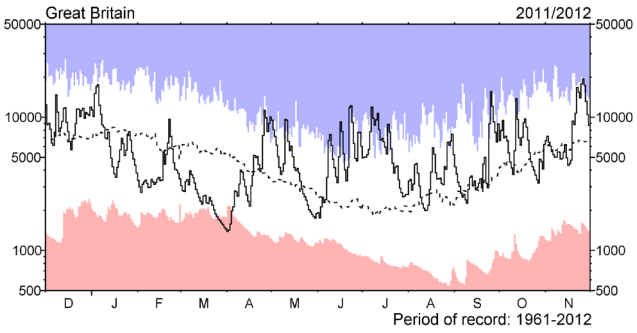
River flow . . . River flow . . .

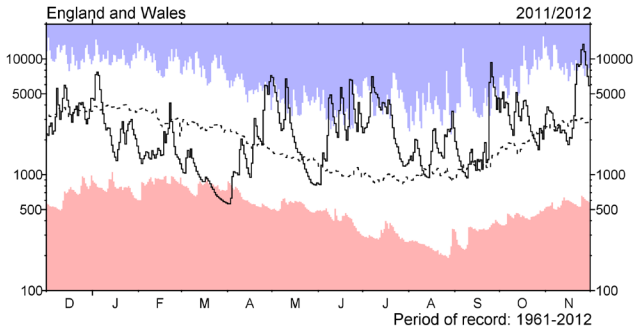


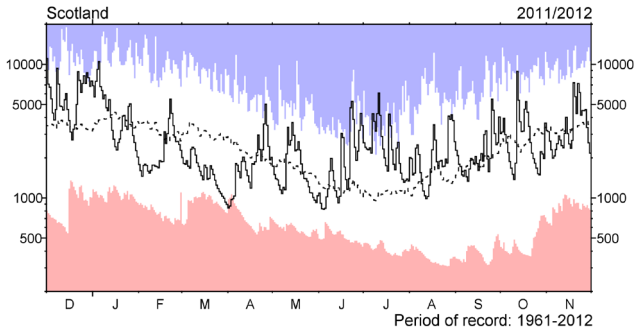
River flows

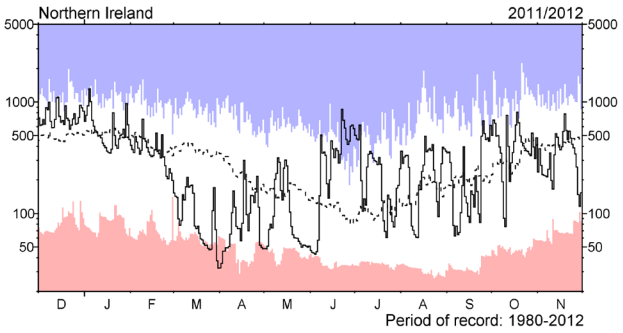
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

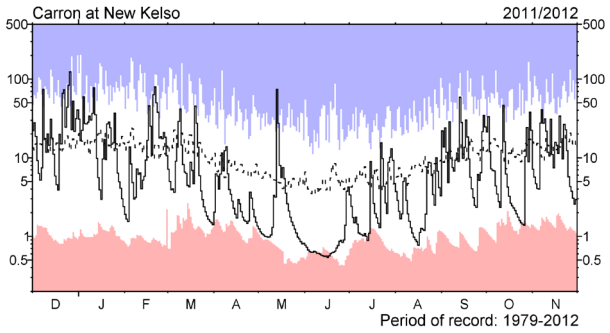
River flow . . . River flow . . .

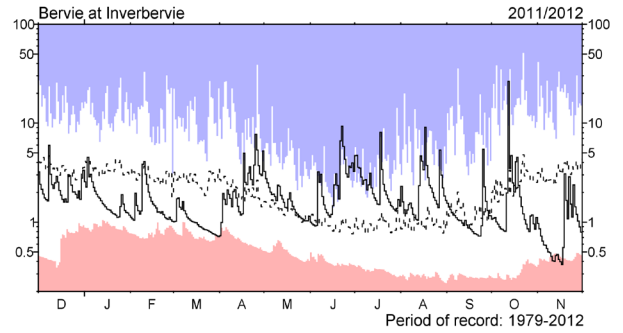


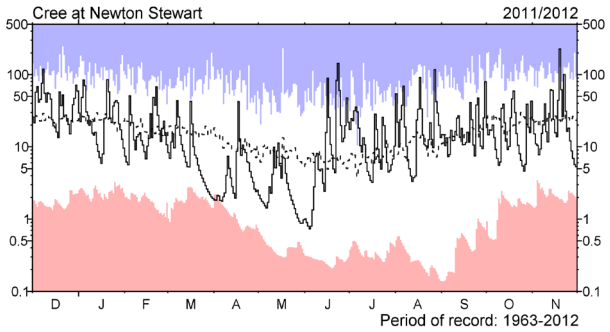


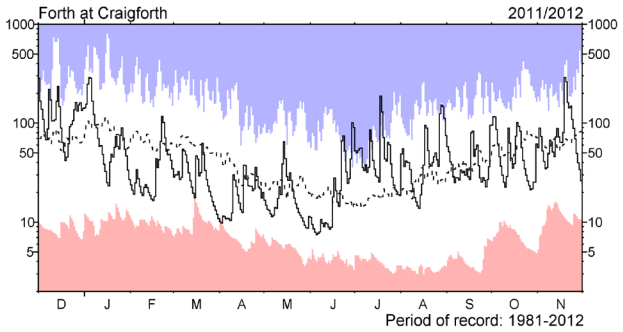


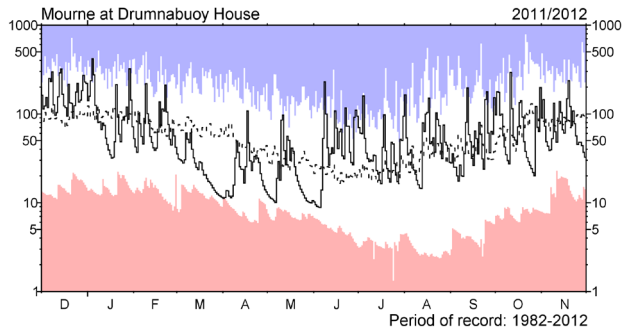


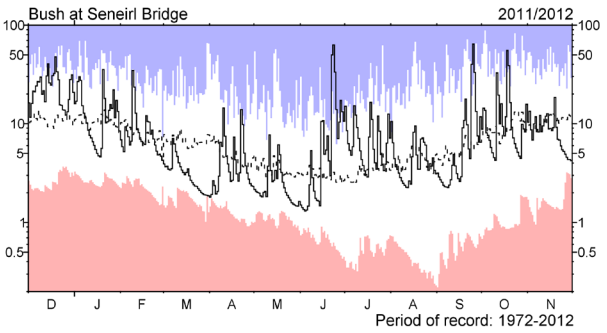








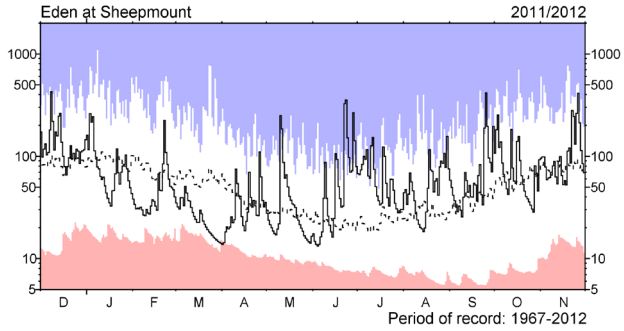


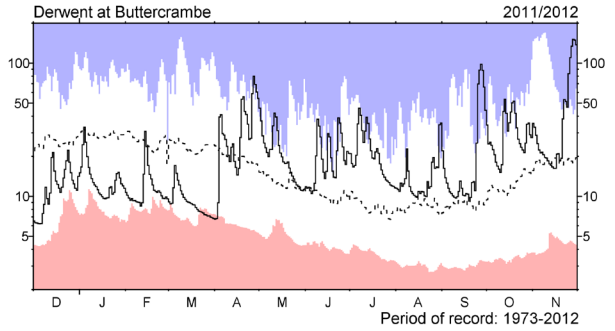


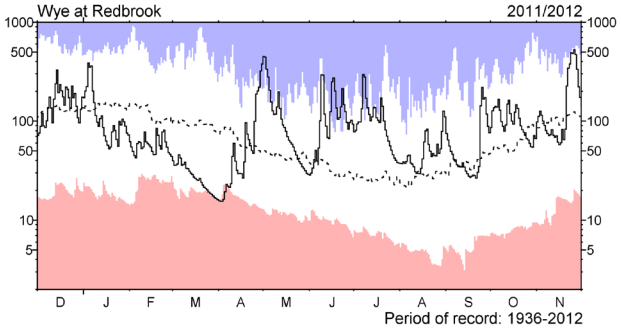
River flow hydrographs

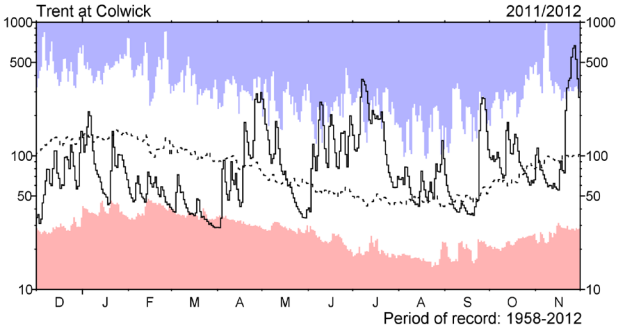
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to December 2011 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

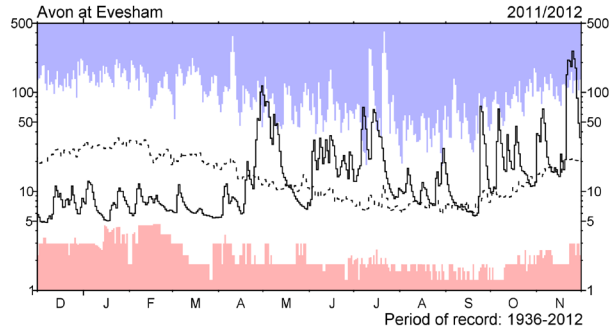
River flow . . . River flow . . .

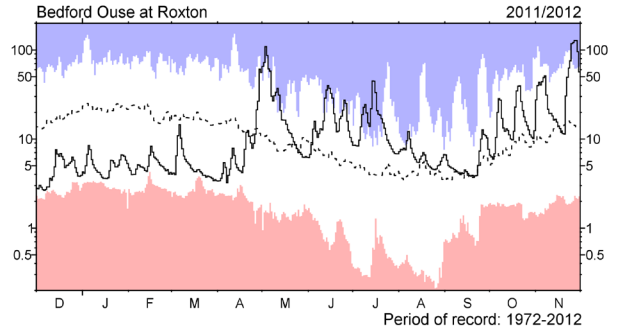


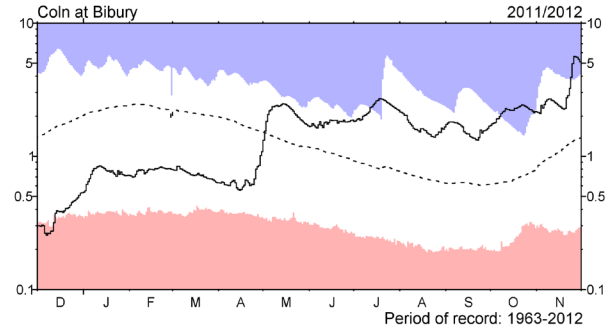


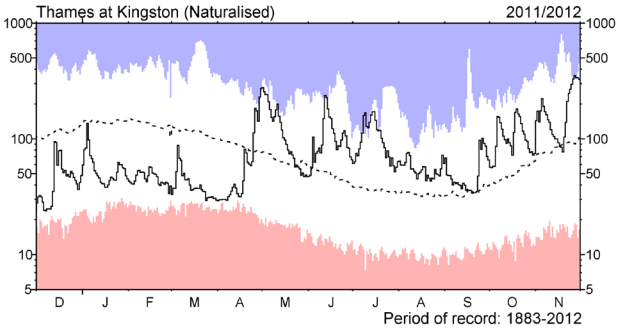


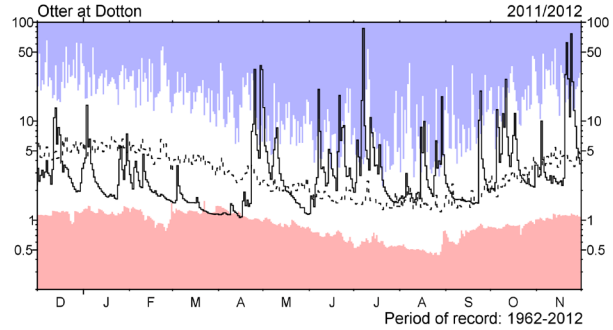


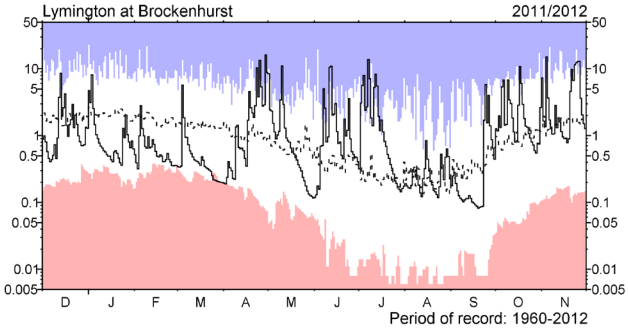












Notable runoff accumulations (a) April 2012 - November 2012

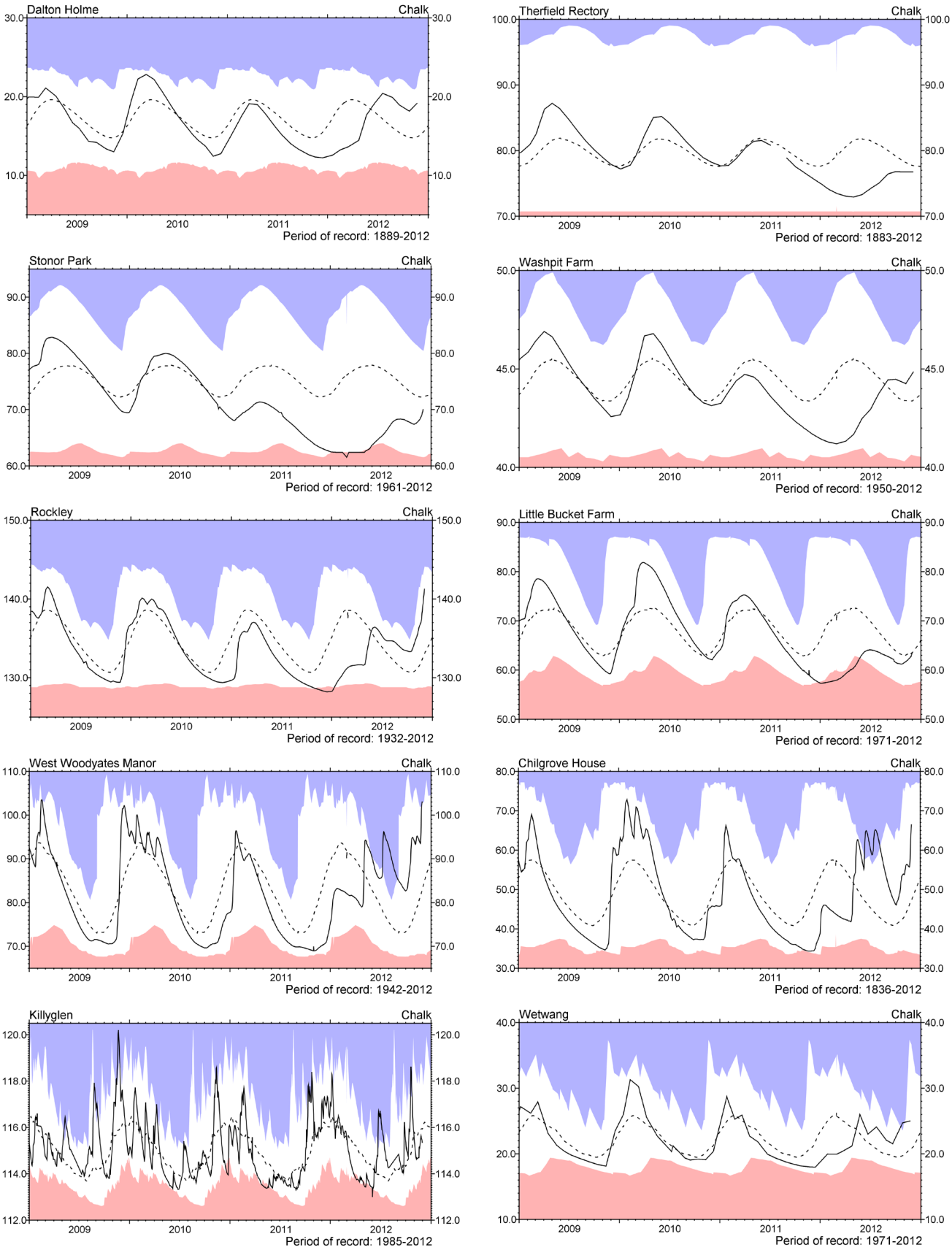
	River	%lta	Rank
a)	Tweed (Norham)	205	50/50
	Tyne (Bywell)	203	53/53
	Ouse (Skelton)	234	37/37
	Dove (Kirkby Mills)	182	40/41
	Dover Beck	250	38/38

	River	%lta	Rank
a)	Bedford Ouse (Roxton)	225	39/39
	Thames (Kingston)	179	128/130
	Blackwater	159	59/60
	Wallington	240	55/57
	Lymington	289	50/50
	Piddle	176	49/49

	River	%lta	Rank
a)	Otter	224	50/50
	Severn (Saxons Lode)	195	41/41
	Tawe	152	51/52
	Dyfi	164	43/44
	Clyde (Blairston)	167	52/52

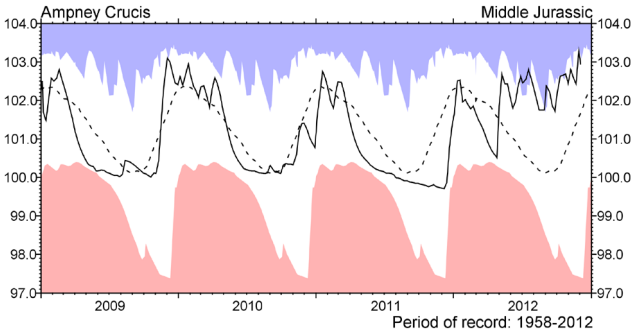
lta = long term average; Rank 1 = lowest on record

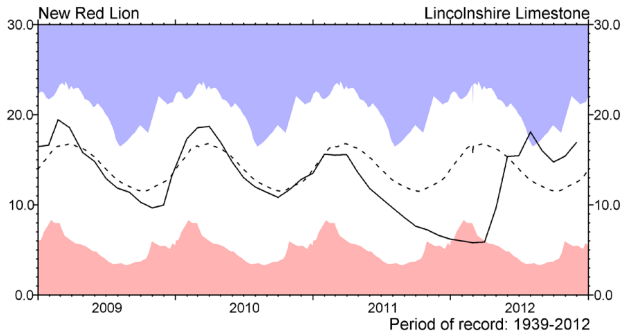
Groundwater…Groundwater

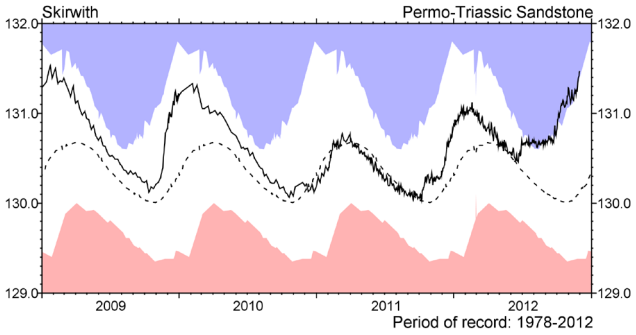


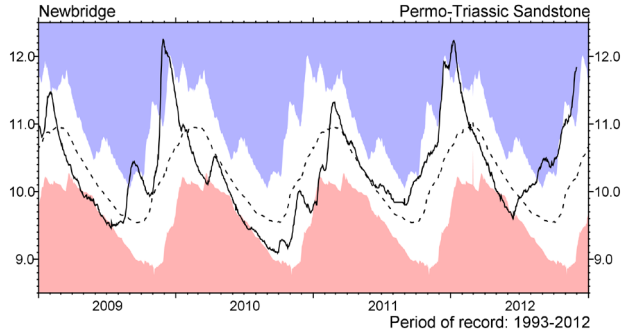
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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. The latest recorded levels are listed overleaf.

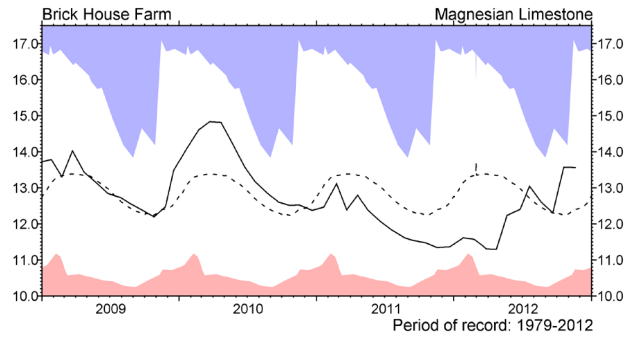
Groundwater... Groundwater

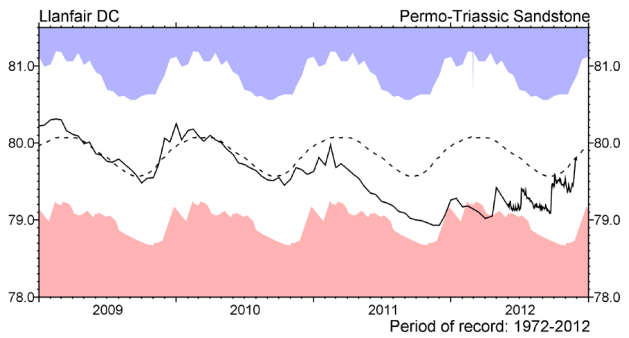


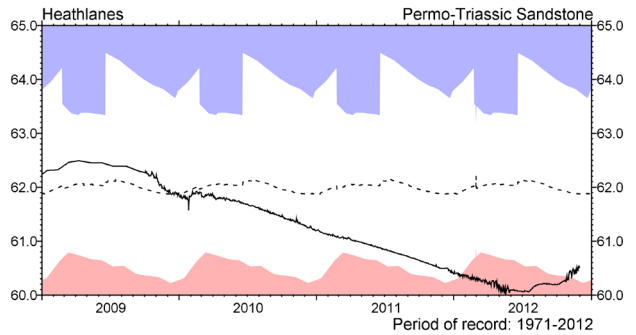


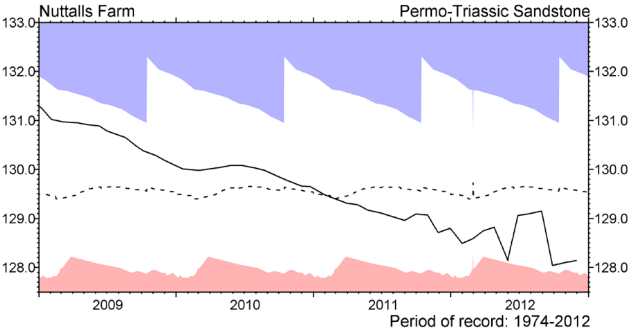


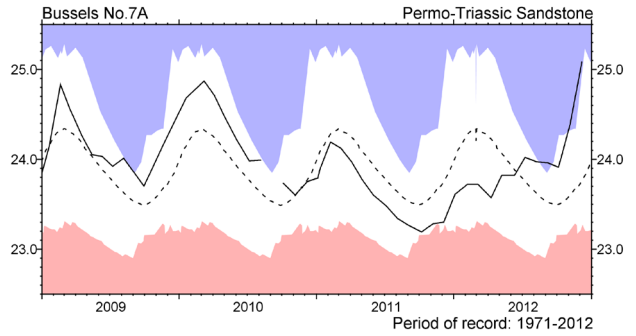


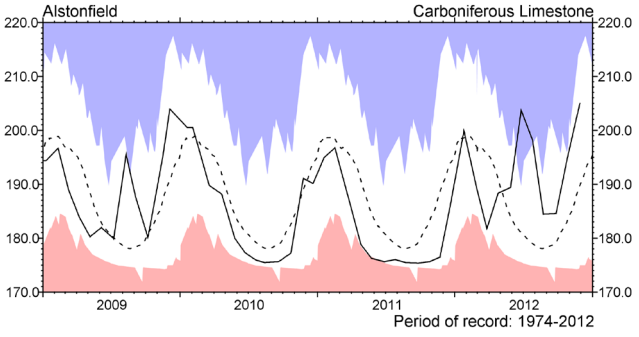








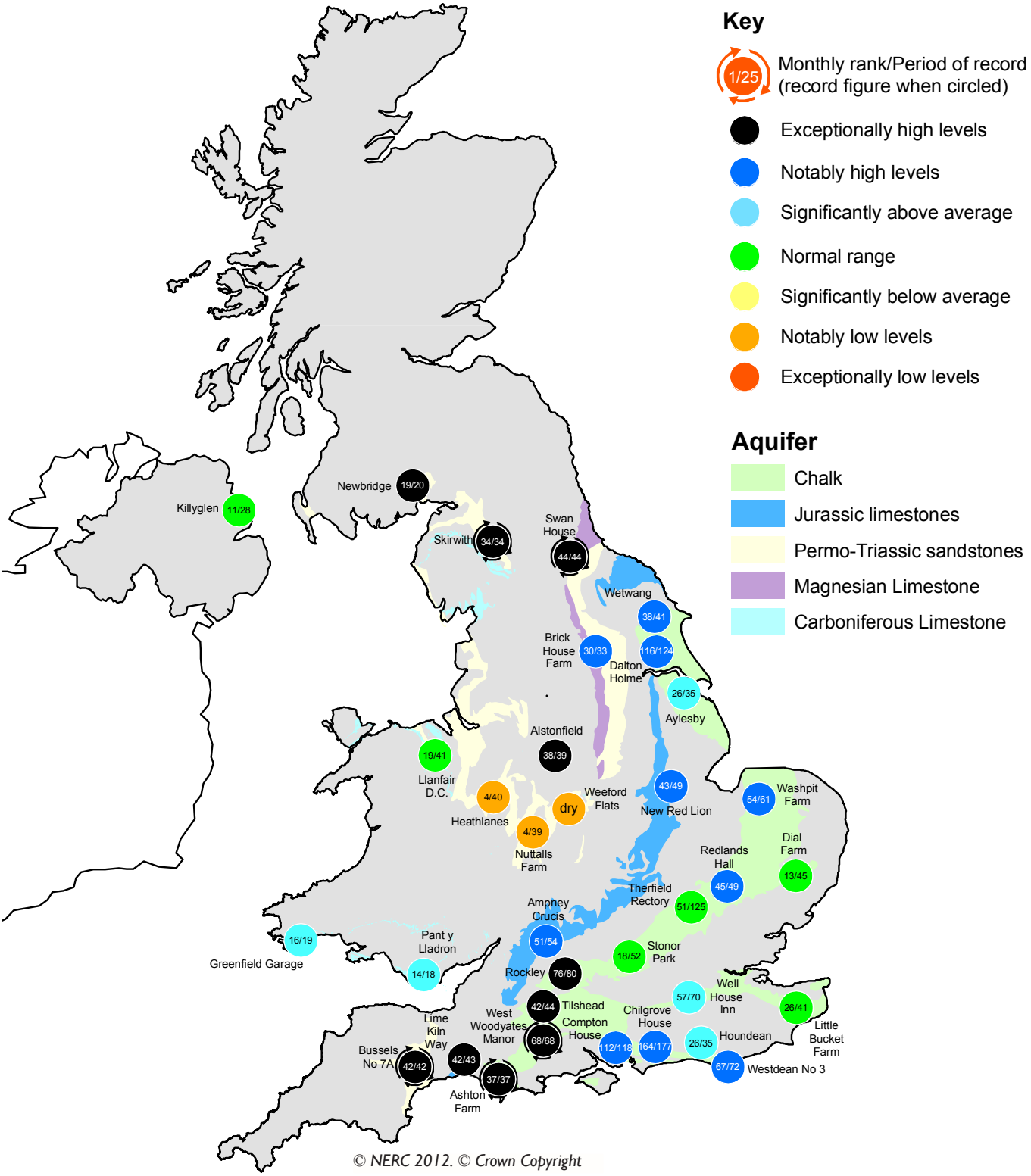




Groundwater levels November / December 2012

Borehole	Level	Date	Nov av.	Borehole	Level	Date	Nov av.	Borehole	Level	Date	Nov av.
Dalton Holme	19.13	21/11	14.77	Chilgrove House	66.64	30/11	46.37	Brick House Farm	13.56	19/11	12.31
Therfield Rectory	76.74	03/12	78.23	Killyglen (NI)	115.35	30/11	115.97	Llanfair DC	79.78	30/11	79.67
Stonor Park	70.01	03/12	72.08	Wetwang	25.00	22/11	20.19	Heathlanes	60.51	30/11	61.85
Tilshead	96.62	30/11	82.45	Ampney Crucis	102.95	03/12	101.18	Nuttalls Farm	128.14	29/11	129.59
Rockley	141.24	03/12	131.58	New Red Lion	16.90	30/11	12.15	Bussels No.7a	25.08	06/12	23.65
Well House Inn	97.10	03/12	92.82	Skirwith	131.45	30/11	130.08	Alstonfield	204.95	28/11	186.80
West Woodyates	102.97	30/11	80.49	Newbridge	11.83	30/11	10.15				

Levels in metres above Ordnance Datum



Groundwater levels - November 2012

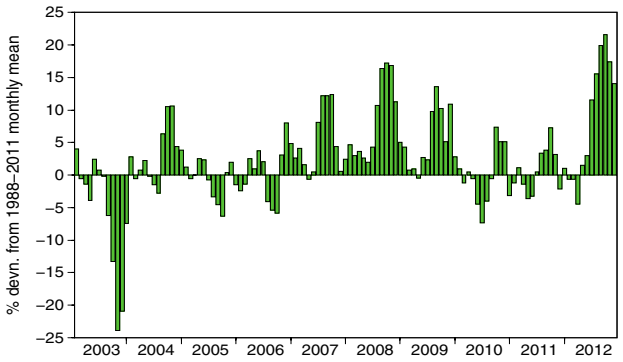
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated.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

Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

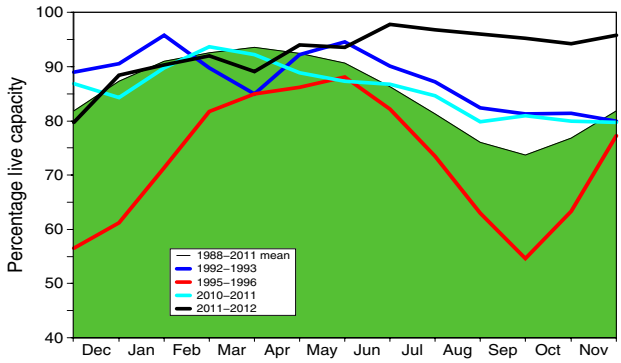
ii. Yew Tree Farm levels are now received quarterly.

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



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2012 Oct	Nov	Dec	Dec Anom.	Min Dec	Year* of min	2011 Dec	Diff 12-11
North West	N Command Zone	•	124929	97	96	94	17	44	1993	81	13
	Vyrnwy		55146	98	93	98	16	33	1995	80	18
Northumbrian	Teesdale	•	87936	97	96	98	18	39	1995	90	8
	Kielder		(199175)	93	90	96	11	55	2007	89	7
Severn Trent	Clywedog		44922	90	87	90	9	43	1995	88	2
	Derwent Valley	•	39525	100	98	100	21	9	1995	72	28
Yorkshire	Washburn	•	22035	98	97	97	23	16	1995	86	11
	Bradford supply	•	41407	100	100	99	17	20	1995	90	9
Anglian	Grafham		(55490)	95	92	83	0	47	1997	82	1
	Rutland		(116580)	98	95	92	14	57	1995	63	29
Thames	London	•	202828	88	95	97	15	52	1990	66	31
	Farmoor	•	13822	92	83	80	-9	52	1990	86	-6
Southern	Bewl		28170	79	58	85	23	34	1990	35	50
	Ardingly*		4685	100	100	100	28	14	2011	14	86
Wessex	Clatworthy		5364	91	100	100	23	16	2003	65	35
	Bristol WW	•	(38666)	97	98	96	30	27	1990	53	43
South West	Colliford		28540	89	92	98	26	42	1995	51	47
	Roadford		34500	92	98	99	25	19	1995	58	41
	Wimbleball		21320	100	100	100	26	34	1995	49	51
	Stithians		4967	93	100	100	36	29	2001	50	50
Welsh	Celyn and Brenig	•	131155	100	94	96	9	50	1995	95	1
	Brianne		62140	100	99	100	5	72	1995	92	8
	Big Five	•	69762	99	99	99	16	49	1990	97	2
	Elan Valley	•	99106	100	100	100	6	47	1995	100	0
Scotland(E)	Edinburgh/Mid Lothian	•	97639	100	100	100	14	45	2003	100	0
	East Lothian	•	10206	100	100	100	12	38	2003	100	0
Scotland(W)	Loch Katrine	•	111363	91	92	91	0	65	2007	97	-6
	Daer		22412	100	99	100	3	73	2003	99	1
	Loch Thom	•	11840	100	100	100	7	72	2003	100	0
Northern Ireland	Total+	•	56920	98	97	98	13	59	2003	91	7
	Silent Valley	•	20634	99	95	98	19	43	2001	91	7

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

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 1988-2011 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

*** The monthly record of Ardingly reservoir stocks is under review.**

Location map…Location map

National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP) was instigated in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS) – both are component bodies of the Natural Environment Research Council (NERC). The National River Flow Archive (maintained by CEH) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Data Sources

River flow and groundwater level data are provided by the Environment Agency (EA), the Environment Agency Wales, the Scottish Environment Protection Agency (SEPA) and, for Northern Ireland, the Rivers Agency 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).

Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

Most rainfall data are provided by the Met Office (address opposite).

To allow better spatial differentiation the monthly rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA.

The monthly, and n-month, rainfall figures have been produced by the Met Office, National Climate Information Centre (NCIC) and are based on gridded data from raingauges. They include a significant number of monthly raingauge totals provided by the EA and SEPA. The Met Office NCIC monthly rainfall series extends back to 1910 and forms 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/Monthly_gridded_datasets_UK.pdf

The regional figures for the current month are based on limited raingauge networks so these (and the return periods associated with them) should be regarded as a guide only.

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

From time to time the Hydrological Summary may also refer to evaporation and soil moisture figures. These are obtained from MORECS, the Met Office services involving the routine calculation of evaporation and soil moisture throughout the UK.

For further details please contact:

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100
Email: enquiries@metoffice.gov.uk

The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

Enquiries

Enquiries should be addressed to:

Hydrological Summaries for the UK
Centre for Ecology & Hydrology
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

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

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:
http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html

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.

NATURAL ENVIRONMENT RESEARCH COUNCIL

12/2012