Hydrological Summary
for the United Kingdom

General

July was a very warm month with rainfall modestly above average for the UK as a whole. The high temperatures, particularly during a mid-month heat-wave, triggered surges in demand which locally overstretched water distribution networks (e.g. in parts of Sussex and South Wales). Overall reservoir stocks declined appreciably through July – by around 7% - but, importantly, they remain marginally above the late summer average, and stocks in all index reservoirs are well above drought minima. A few notable storms generated significant summer spates but generally rivers were in recession and July runoff totals were mostly within the normal seasonal range, albeit below average in most cases. A similar generalisation applies to groundwater levels in most of the outcrop areas of the major aquifers. However, early August increases in soil moisture deficits have left many eastern and southern catchments exceptionally dry and, given normal rainfall, a significant delay in the seasonal recovery in river flows and groundwater levels may be expected. In the English Lowlands, the recovery may need to be generated from a considerably lower base than in the last four years.

July 2003

Rainfall

July rainfall totals displayed substantial spatial variability - reflecting the thundery and showery nature of much of the rainfall. Mid-month and the final week were particularly unsettled as vigorous frontal systems crossed the British Isles, mostly from the south-west. Accordingly, a few localities in Cornwall and South Wales recorded over twice the July average rainfall. By contrast, areas in the rain-shadow of the western hills, and which missed the thunderstorms, were relatively dry – parts of the west Midlands recorded <60% of the July average; some catchments along the eastern seaboard were even drier. High intensity rainfall events were particularly common in mid-month and towards month end. On the 17th, St Athan (South Wales) recorded 55 mm whilst Newry (Northern Ireland) registered 70 mm on the following day. On the 25th, Cardinham (Cornwall) reported 62 mm and, at month-end, a remarkably intense storm produced a three-hour total of 54 mm at Borgue (Dumfries & Galloway) - estimated return period > 100 years. Regional rainfall totals for July were mostly in the normal range across England & Wales but, once again, well below average across much of Scotland. The episodic nature of the 2003 weather patterns is reflected in the accumulated rainfall totals. For Northern Ireland, the May-July period was the wettest since 1958 and most regional totals (northern Scotland excepted) were appreciably above average. However, in the 6-month timeframe regional totals are mostly below average, remarkably so in northern Scotland where deficiencies now extend over 12 months; the August-July rainfall was the lowest since 1969 for the Highland Region.

River Flows

The first half of July saw a continuation of the seasonal recession in most catchments with relatively depressed flows characterising many rivers draining impermeable catchments late in the second week. Thereafter, spates in mid-month, and more particularly towards month end in the west, generated a steep but short-lived recovery with notably high late-summer flows reported for some western catchments; localised urban flooding was also common. July runoff totals were depressed across north-eastern Britain – commonly the lowest since August 1995 – and new minimum 12-month accumulations were established in a few Scottish catchments (e.g. the Carron). To the south, most runoff totals were in the normal range but the Camowen (NI) reported its 2nd highest July flow. After an unprecedented sequence of above average monthly runoff totals, flows in many spring-fed eastern streams (including the Mimram) are now close to the late summer mean. Annual minimum flows in recent years have generally been considerably greater than those recorded over the 1989-1997 period. Given the parched condition of many eastern and southern catchments it is likely that this sequence will terminate this year with the possibility of notably low early autumn flows across the English Lowlands in particular.

Groundwater

Soil moisture deficits increased erratically in July but, notwithstanding the late July rainfall, they were considerably above average across most major outcrop areas by month-end, and increased further in early August. Infiltration during July was, as usual, minimal and groundwater level recessions continued in all the major aquifers. Recessions in the Chalk are generally following a typical shallow summer decline but groundwater levels in the most southerly outcrops are depressed (e.g. at Compton). Levels are also well below the average in the Jurassic Limestone of the Cotswolds (e.g. at Ampney Crucis) but generally within the normal range in the other limestone aquifers. In the Permo-Triassic sandstones levels in the Llanfair DC and Heathlanes index boreholes have closely approached the average for first time since 1999; the Yew Tree Farm hydrograph is also in sustained decline but has only just fallen below pre-2000 maxima. Overall groundwater resources are around the average for the time of year but, in the driest eastern outcrop areas particularly, the onset of the seasonal recovery is unlikely to be before the early winter.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Jul 2003	May 03-Jul 03	RP	Feb 03-Jul 03	RP	Oct 02-Jul 03	RP	Aug 02-Jul 03	RP
England & Wales	**mm**	**73**	**220**		**338**		**897**		**1014**	
	%	**118**	**114**	**2-5**	**86**	**2-5**	**118**	**5-15**	**111**	**2-5**
North West	mm	89	274		454		1006		1161	
	%	104	114	2-5	94	2-5	103	2-5	96	2-5
Northumbrian	mm	54	194		283		716		834	
	%	84	104	2-5	76	5-15	102	2-5	98	2-5
Severn Trent	mm	58	192		293		695		781	
	%	110	112	2-5	86	2-5	112	5-10	104	2-5
Yorkshire	mm	55	220		327		763		912	
	%	93	123	5-10	90	2-5	112	2-5	111	2-5
Anglian	mm	53	185		250		612		701	
	%	109	125	5-10	90	2-5	124	10-20	118	5-15
Thames	mm	51	147		231		677		744	
	%	105	92	2-5	74	5-10	118	5-10	108	2-5
Southern	mm	56	140		230		740		823	
	%	116	90	2-5	71	5-15	113	2-5	106	2-5
Wessex	mm	74	180		295		847		926	
	%	143	106	2-5	83	2-5	121	5-15	110	2-5
South West	mm	111	261		446		1112		1188	
	%	160	124	5-10	93	2-5	112	2-5	101	2-5
Welsh	mm	110	293		494		1211		1330	
	%	143	123	5-10	95	2-5	110	2-5	101	2-5
Scotland	**mm**	**79**	**295**		**494**		**1059**		**1194**	
	%	**84**	**111**	**2-5**	**87**	**5-10**	**90**	**5-10**	**83**	**10-20**
Highland	mm	75	340		586		1137		1253	
	%	70	115	2-5	87	2-5	78	20-35	71	150-250
North East	mm	42	174		295		859		994	
	%	57	84	2-5	72	20-30	108	2-5	102	2-5
Tay	mm	71	257		436		1025		1163	
	%	93	110	2-5	87	2-5	100	<2	95	2-5
Forth	mm	78	242		386		888		1031	
	%	104	111	2-5	86	2-5	98	2-5	93	2-5
Tweed	mm	74	222		336		827		946	
	%	102	106	2-5	82	5-10	104	2-5	97	2-5
Solway	mm	108	311		525		1207		1381	
	%	120	120	2-5	95	2-5	104	2-5	97	2-5
Clyde	mm	112	381		608		1227		1390	
	%	103	130	5-15	95	2-5	89	5-10	82	10-20
Northern Ireland	**mm**	**89**	**295**		**458**		**1002**		**1098**	
	%	**133**	**141**	**10-20**	**104**	**2-5**	**115**	**5-10**	**104**	**2-5**

RP = Return period

 All monthly totals since December 1998 are provisional (see page 12). The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used to derive the CRU data series. The return period estimates are based on tables provided by the Meteorological Office (see Tabony, R.C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37) and relate to the specified span of months only (return periods may be up to an order of magnitude less if n-month periods beginning in any month are considered); RP estimates for Northern Ireland are based on the tables for north-west England. The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts, in the Scottish rainfall series in particular, can exaggerate the relative wetness of the recent past.

*See page 12.

Rainfall . . . Rainfall . .

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

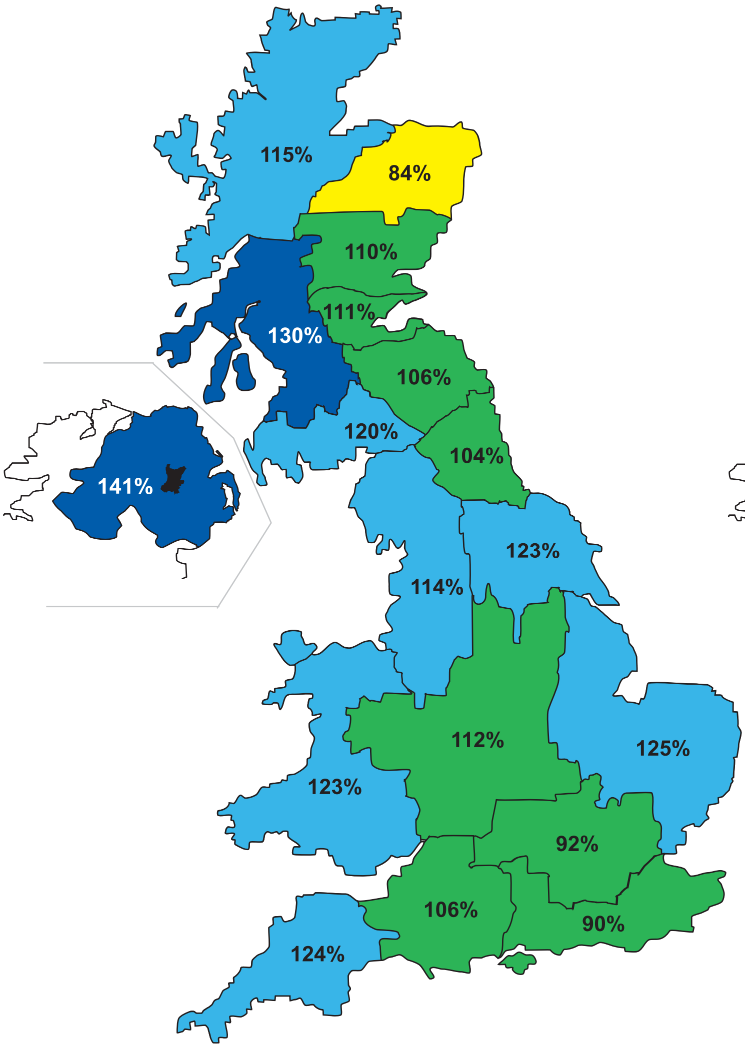
Above average

Normal range

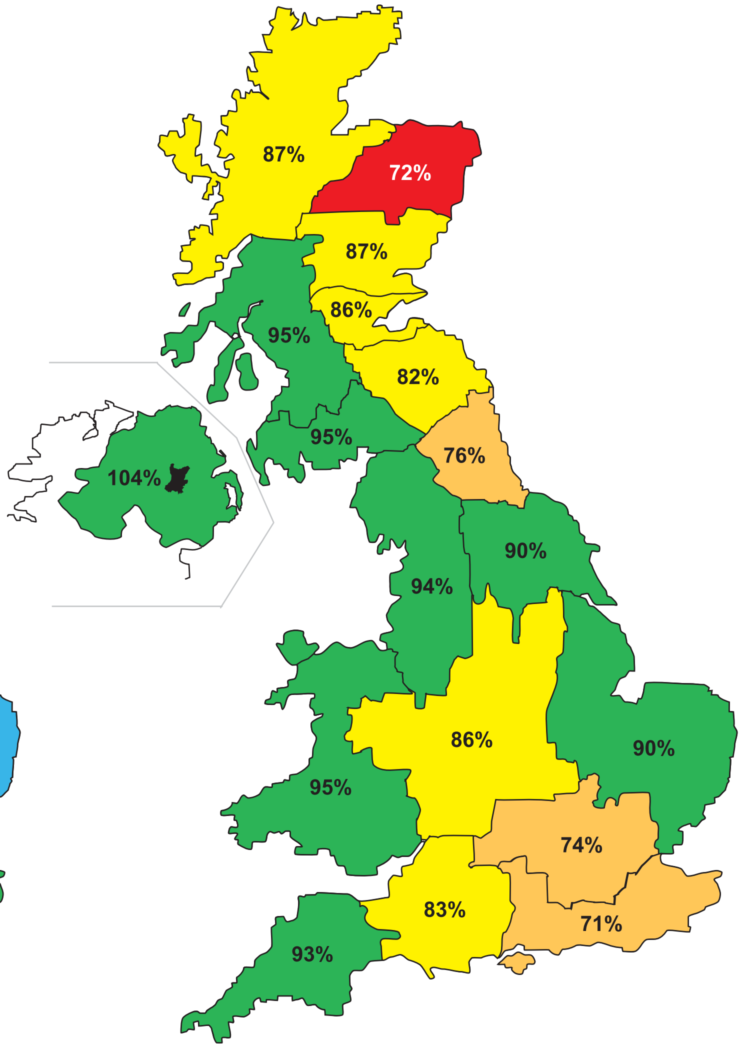
Below average

Substantially below average

Exceptionally low rainfall



May 2003 - July 2003

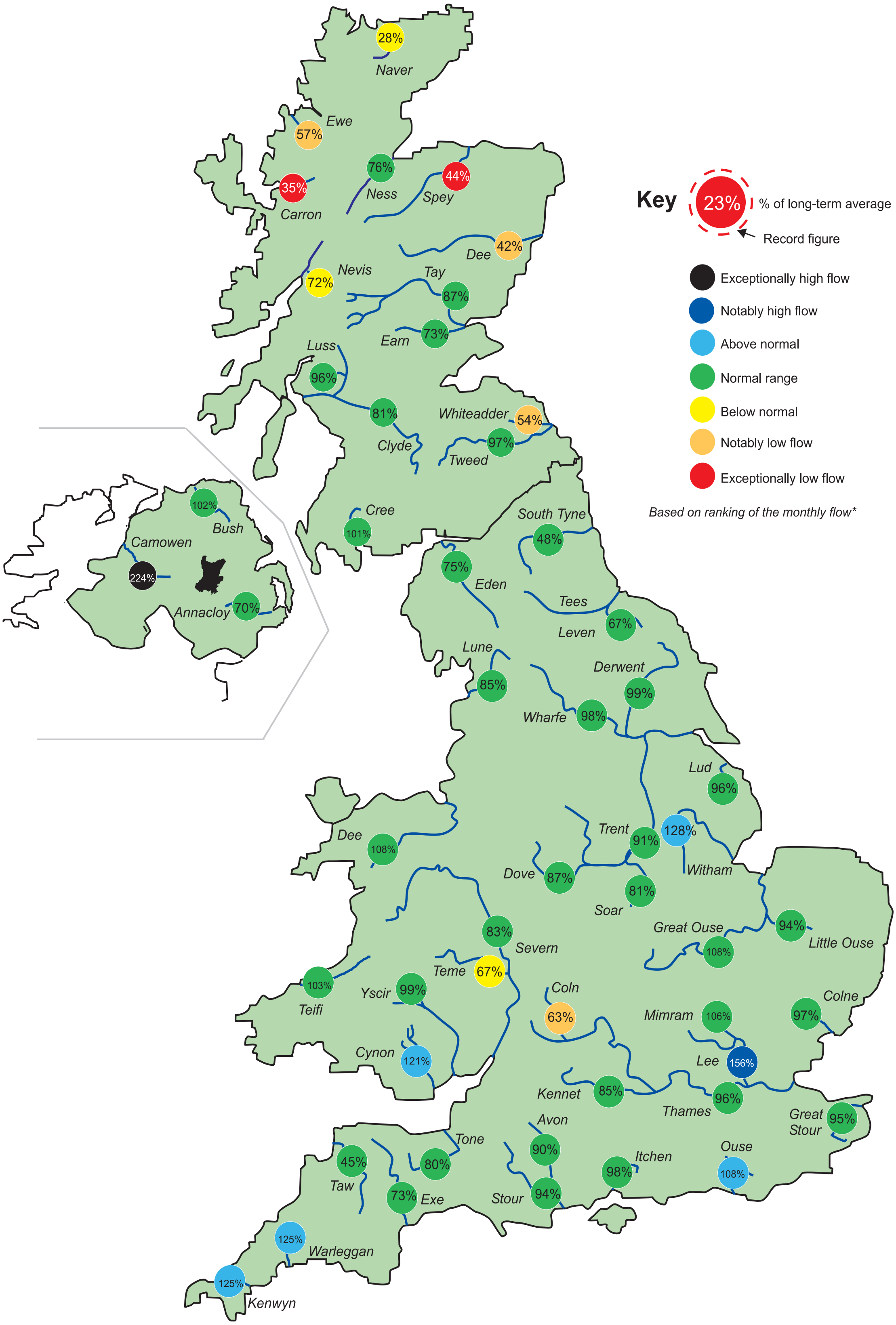


February 2003 - July 2003

Rainfall accumulation maps

Rainfall over the last three months for the UK as a whole has added to a cluster of wet May-July periods: since 1996, four have registered well above average rainfall. By contrast, all regions of Britain have recorded below average rainfall since January 2003. The February-July period was the second driest for the UK since 1984 - for parts of southern England it was the second driest such period since 1976 (and the driest in parts of north-east Scotland).

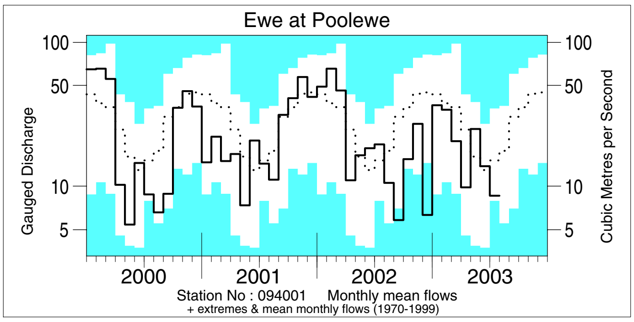
River flow . . . River flow . . .

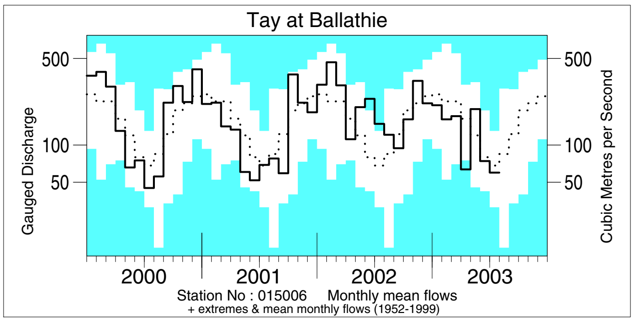


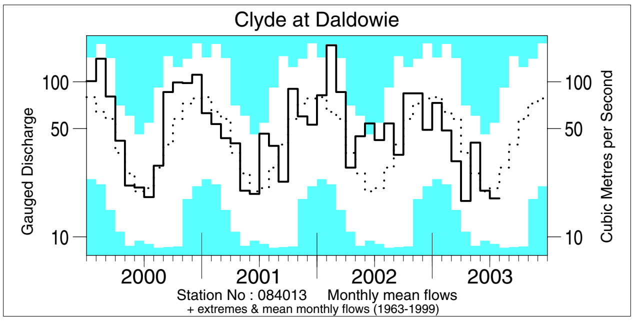
River flows – July 2003

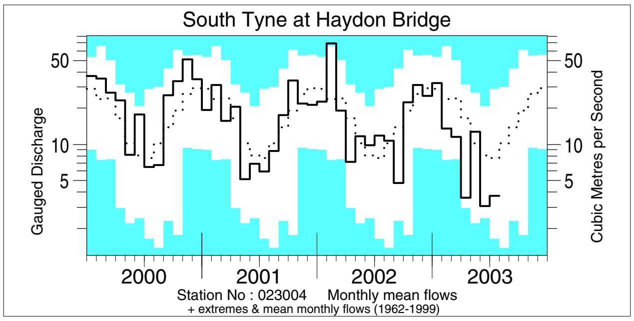
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

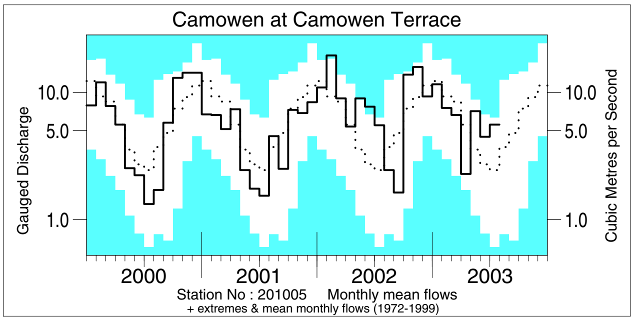
River flow . . . River flow . . .

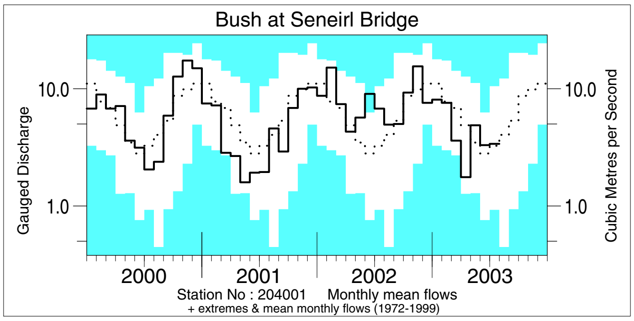


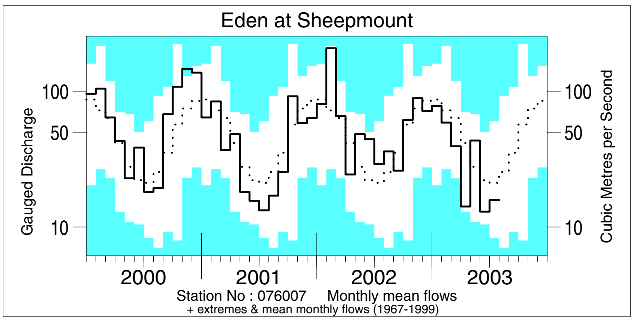


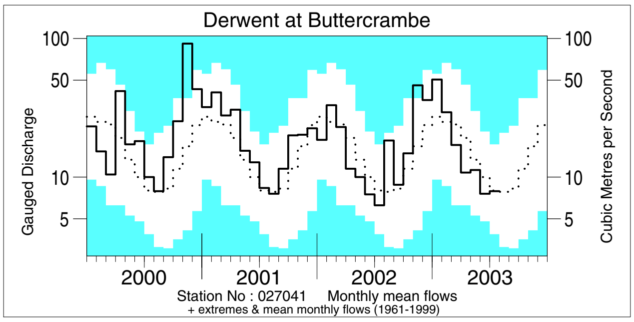


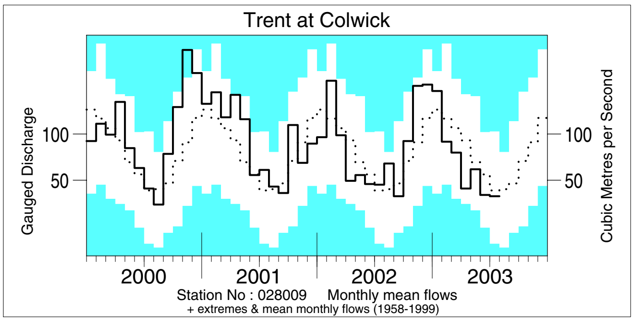


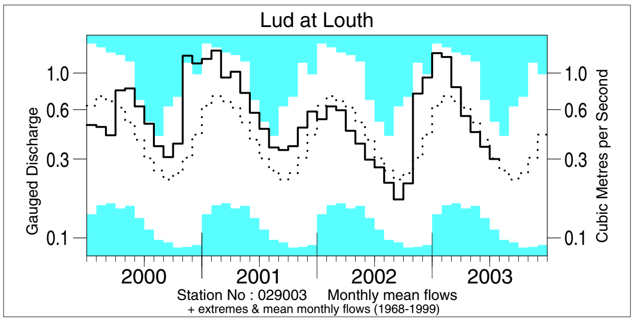








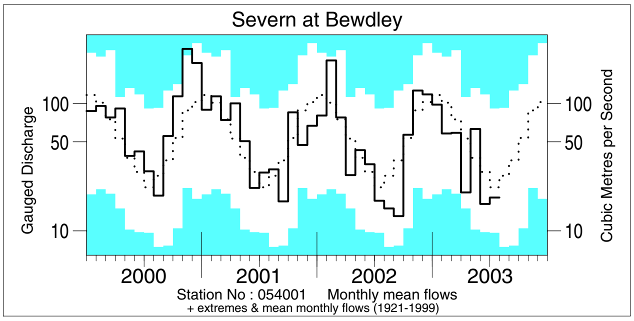


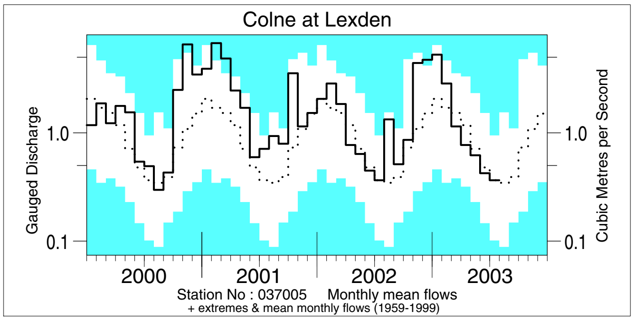


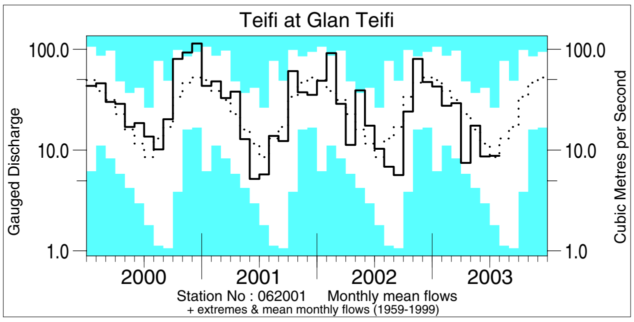
Monthly river flow hydrographs

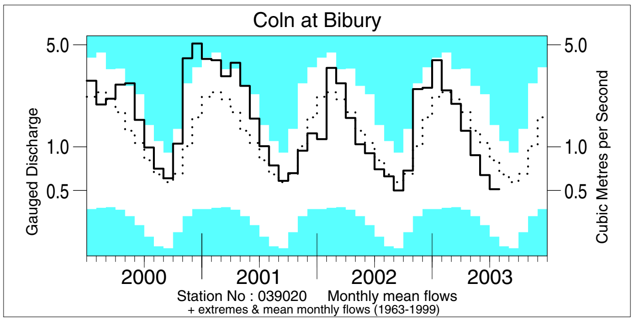
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

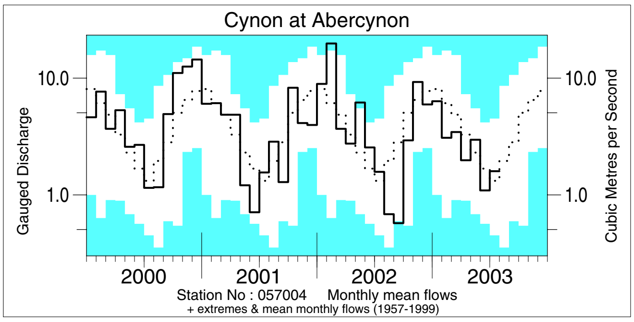
River flow . . . River flow . . .

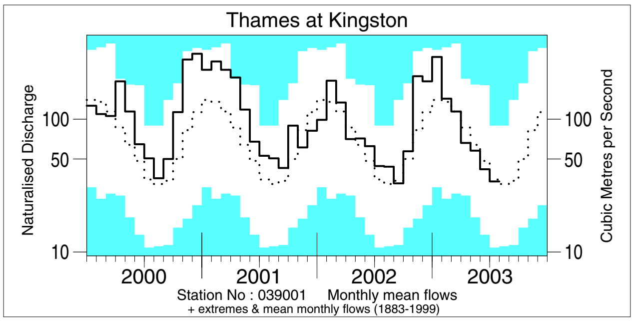


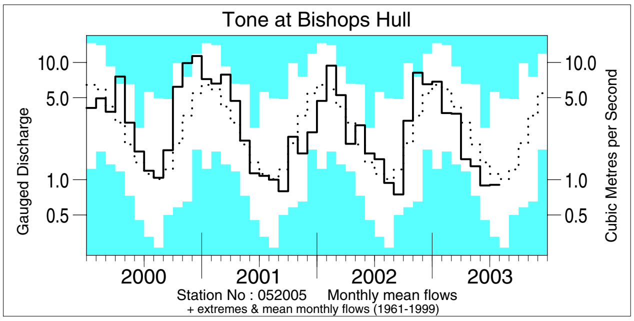


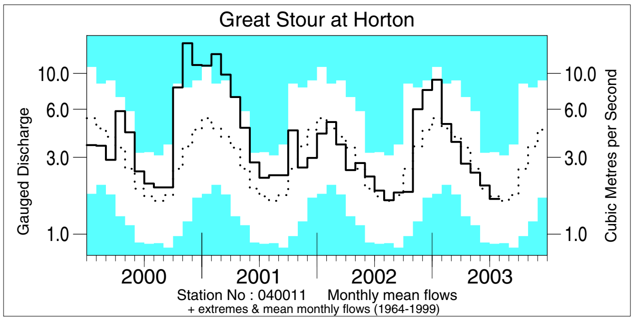


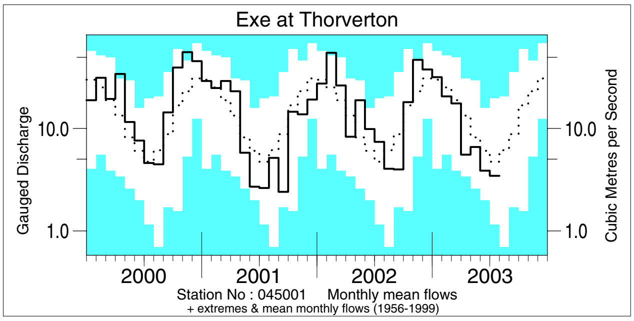


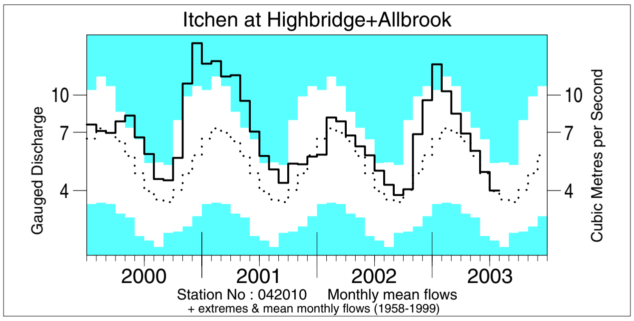












Notable runoff accumulations (a) May 2003 - July 2003, (b) February 2003 - July 2003, (c) August 2002 - July 2003

a)

River	%lta	Rank
Leven (Leven Bridge)	49	6/43
Thames (gauged)	60	31/121
Coln	63	5/40
Dee (New Inn)	143	31/34
Leven (Linnbrane)	159	36/40
Camowen	186	31/32
Annacloy	144	20/24

b)

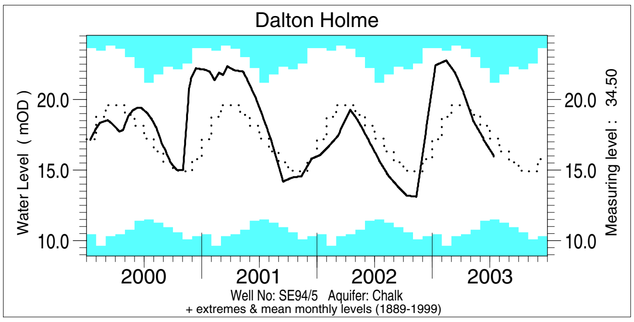
River	%lta	Rank
Spey (Boat o' Brig)	67	2/51
Dee (Park)	69	2/31
Whiteadder	47	2/34
South Tyne	53	1/40
Soar	53	3/32
Taw	57	3/45
Teme	62	4/33

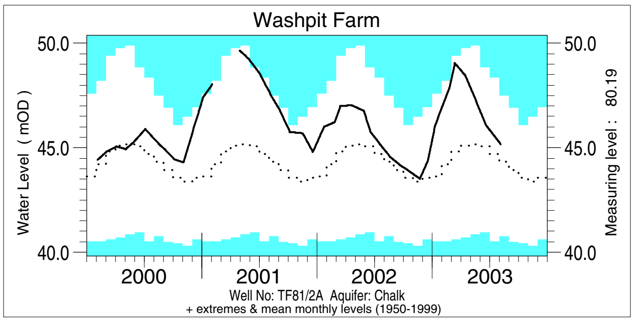
c)

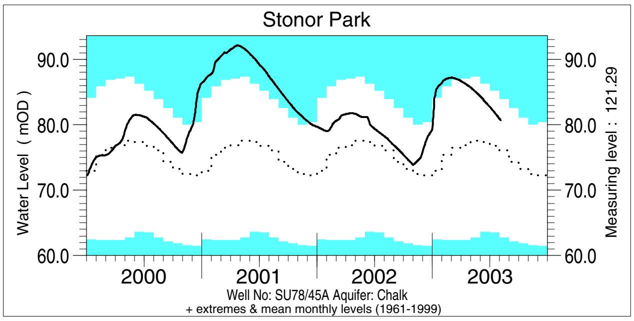
River	%lta	Rank
Ness	59	2/30
Cree	80	2/39
Luss	68	1/23
Nevis	65	1/20
Carron	48	1/24
Ewe	60	1/32
Naver	70	1/26

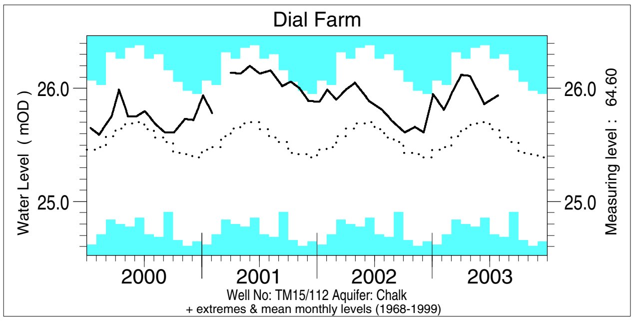
lta = long term average
Rank 1 = lowest on record

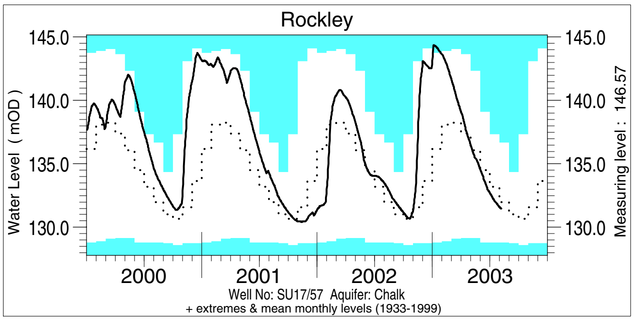
Groundwater . . . Groundwater

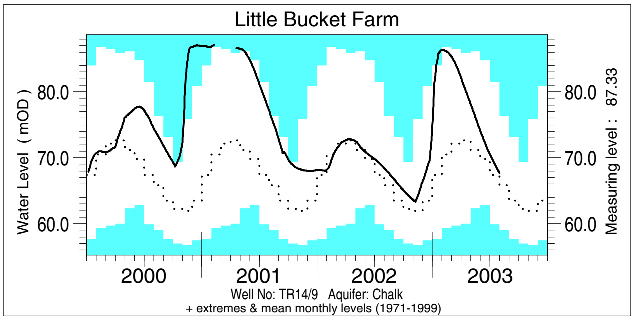


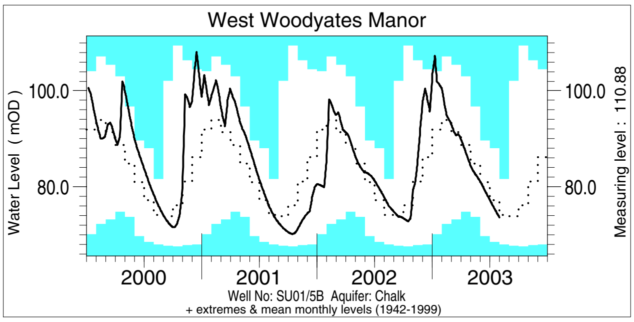


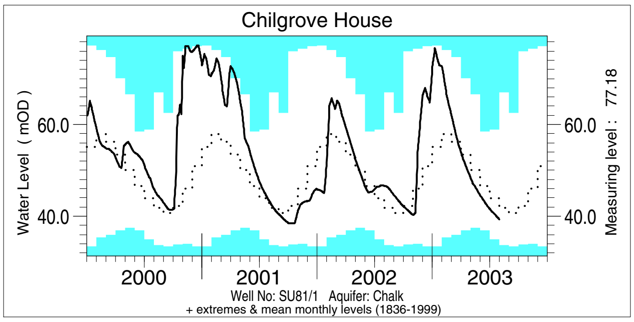


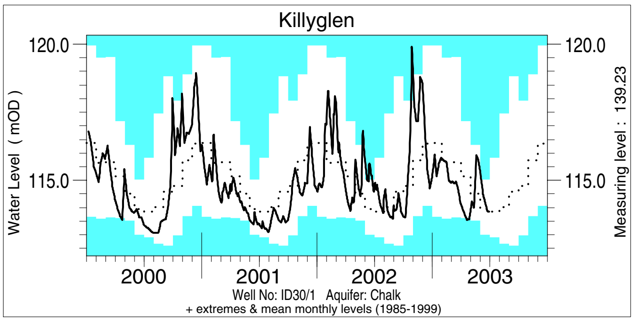


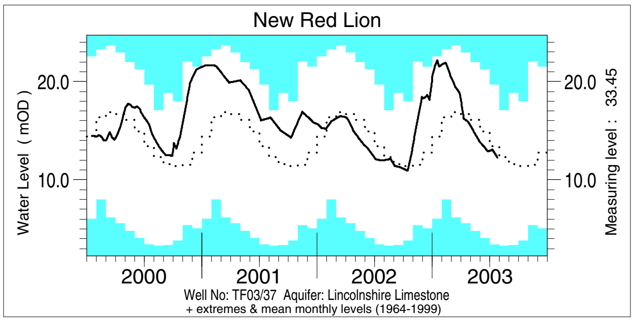






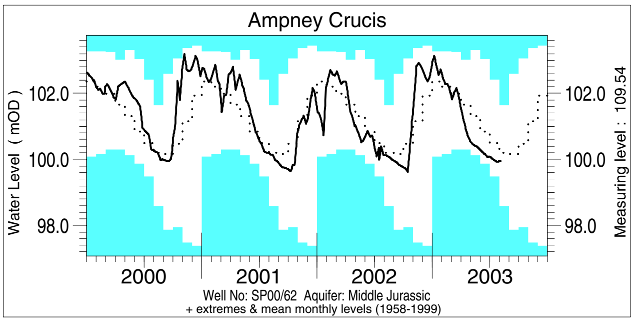


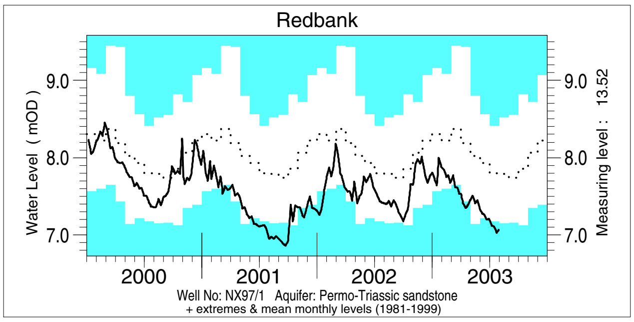


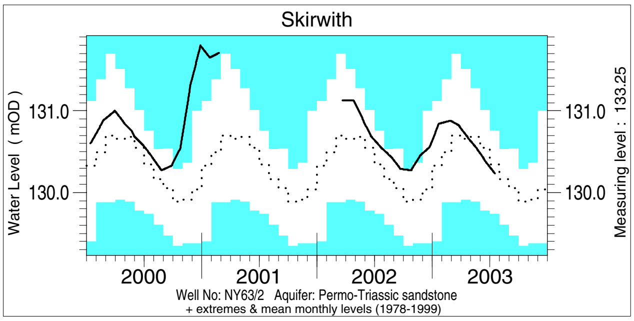


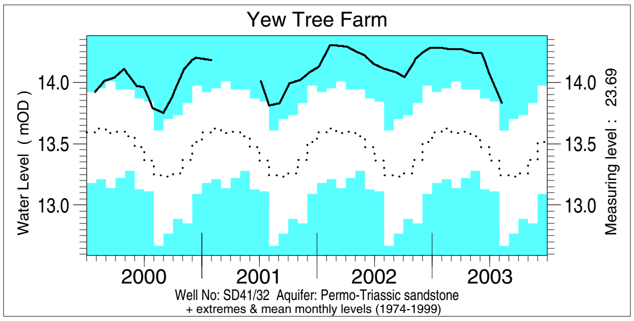
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly max., min. and mean levels are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously – the latest recorded levels are listed overleaf.

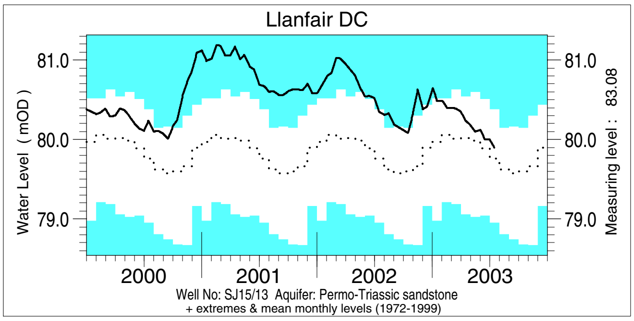
Groundwater . . . Groundwater

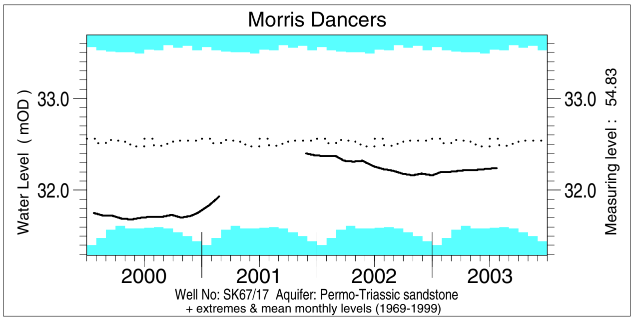


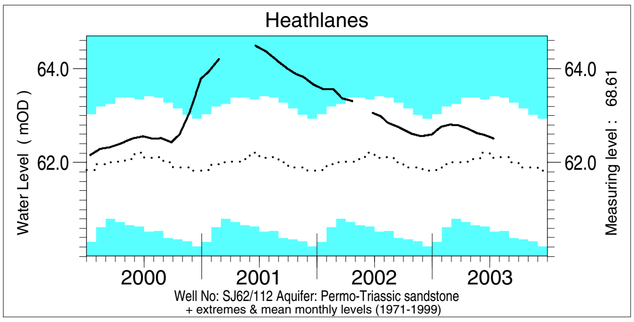


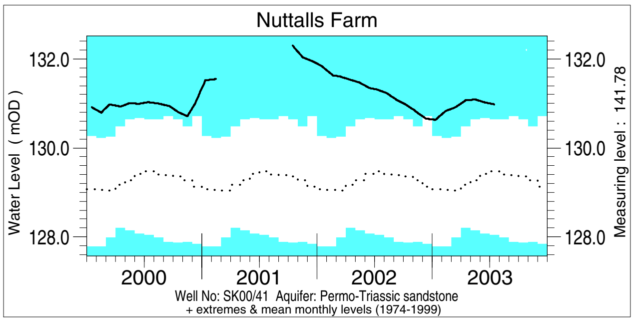


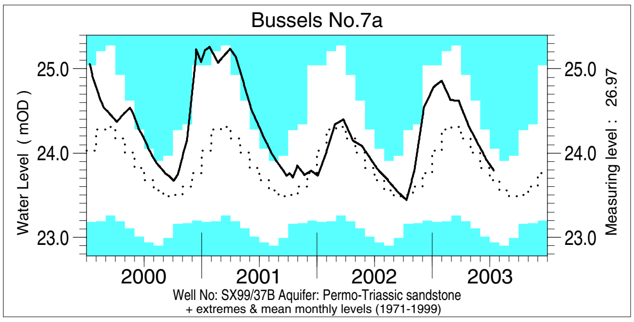


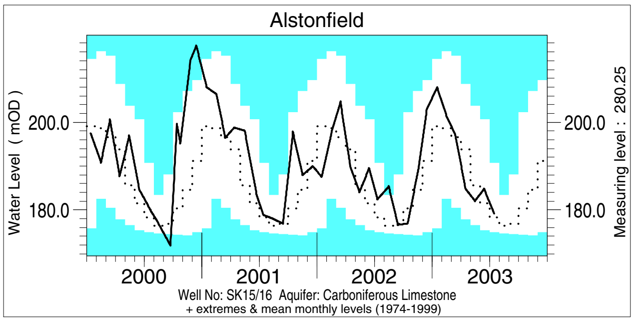










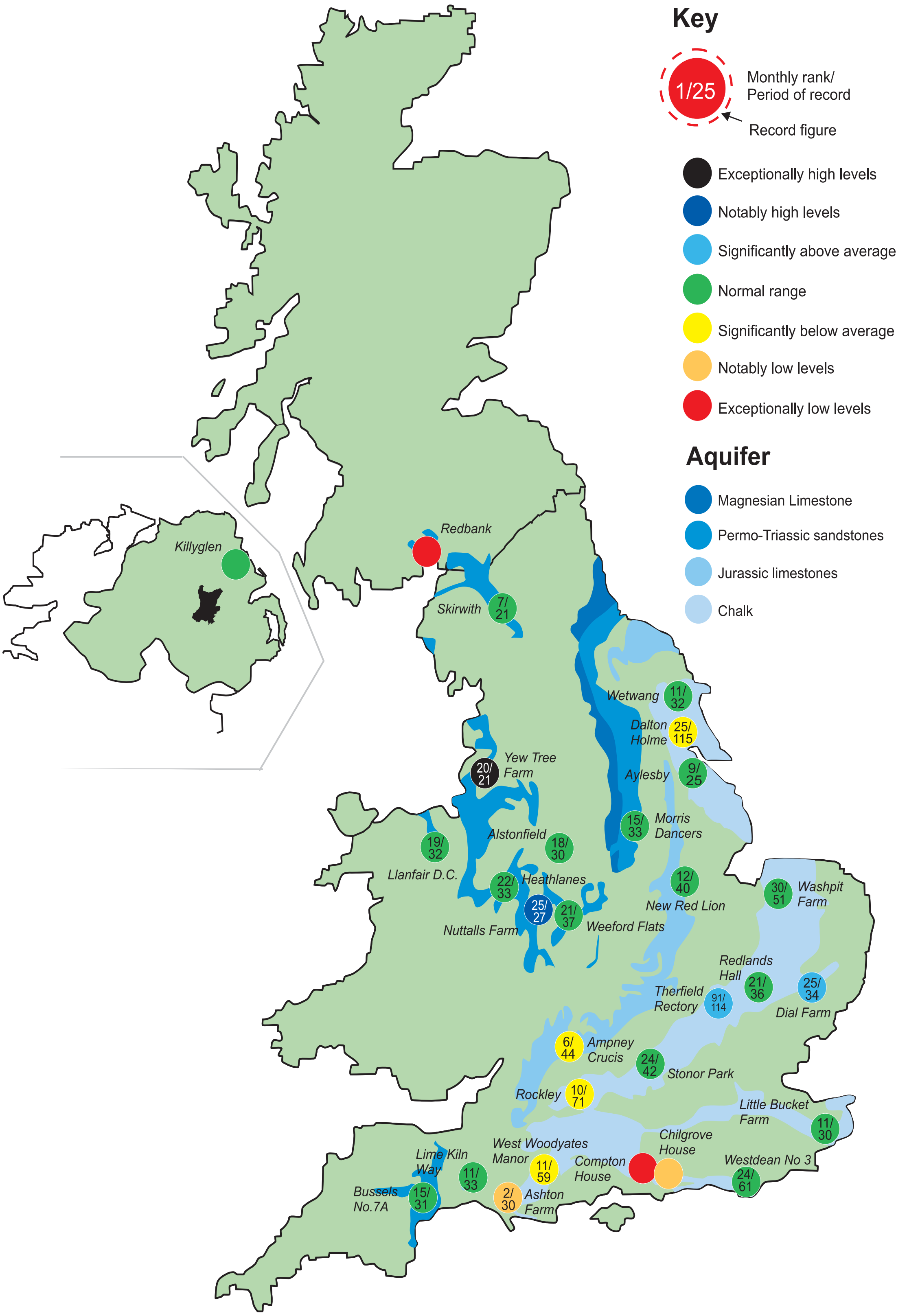


Groundwater levels July 2003 / August 2003

Borehole	Level	Date	Jul. av.	Borehole	Level	Date	Jul. av.	Borehole	Level	Date	Jul. av.
Dalton Holme	15.98	14/07	17.19	Chilgrove House	39.32	31/07	43.61	Llanfair DC	79.90	15/07	79.73
Washpit Farm	45.17	04/08	44.86	Killyglen	113.84	29/06	113.78	Morris Dancers	32.24	24/07	32.37
Stonor Park	80.71	04/08	77.66	New Red Lion	12.27	25/07	13.41	Heathlanes	62.51	14/07	62.19
Dial Farm	25.94	28/07	25.67	Ampney Crucis	99.94	04/08	100.45	Nuttalls Farm	130.98	15/07	129.59
Rockley	131.46	06/08	133.23	Redbank	7.07	30/07	7.77	Bussels No.7a	23.79	14/07	23.73
Little Bucket Farm	67.68	31/07	68.91	Skirwith	130.23	17/07	130.29	Alstonfield	179.14	15/07	179.05
West Woodyates	73.62	31/07	77.00	Yew Tree Farm	13.83	08/08	13.48				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

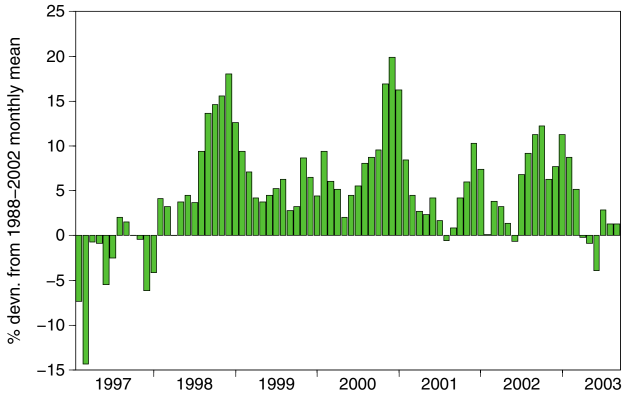


Groundwater levels - July 2003

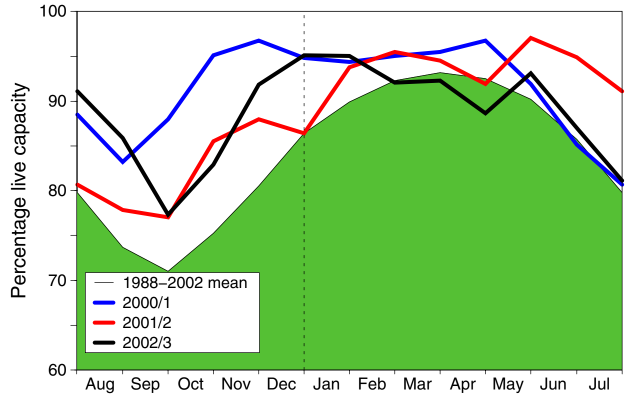
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

(Note: Redbank is affected by groundwater abstraction.)

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.

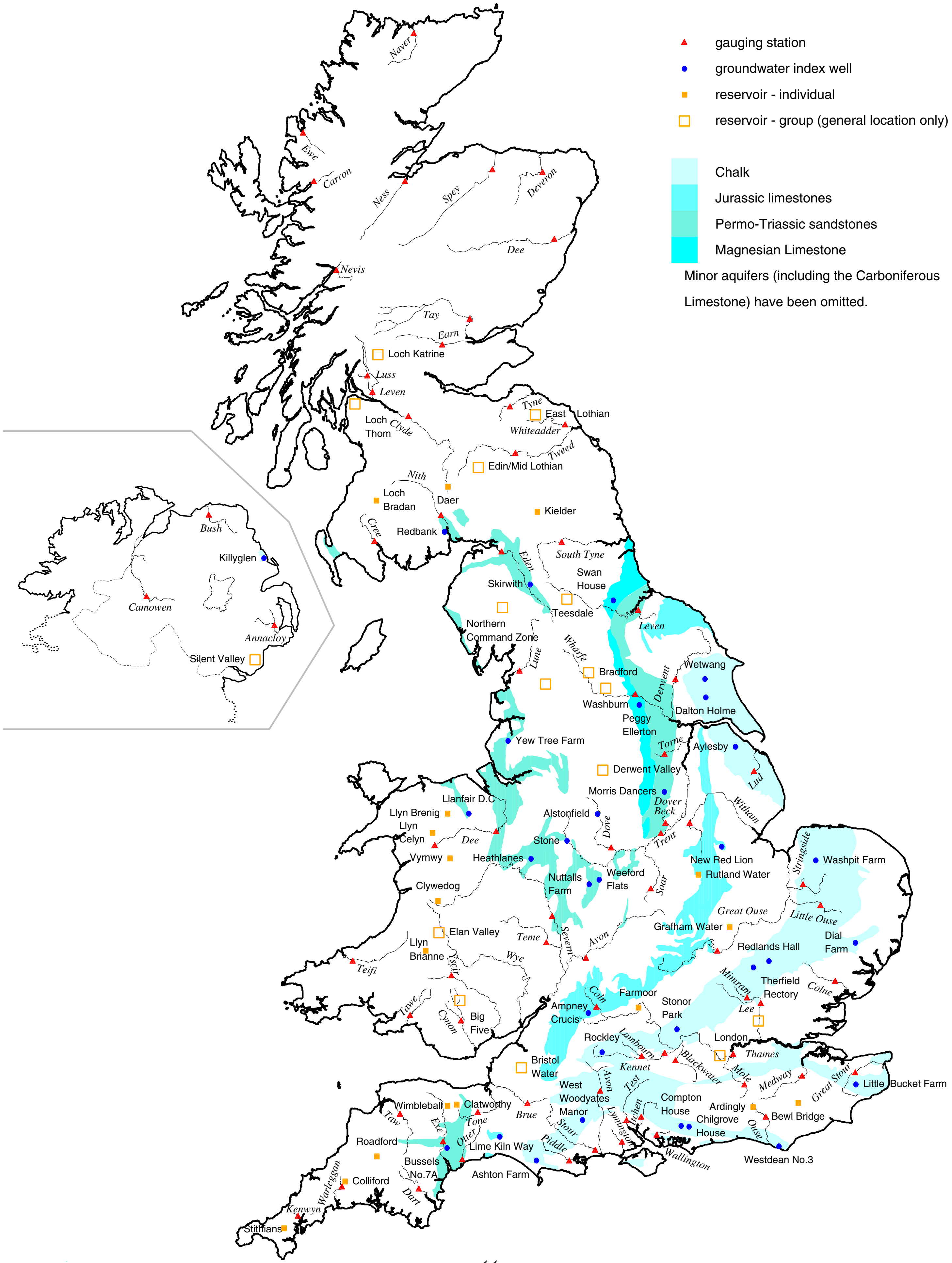
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2003 Mar	Apr	May	Jun	Jul	Aug	Min. Aug	Year* of min.
North West	N Command Zone	•	124929	89	88	74	85	69	**62**	38	1989
	Vyrnwy		55146	92	94	90	97	87	**82**	56	1996
Northumbrian	Teesdale	•	87936	79	77	74	75	72	**60**	45	1989
	Kielder		(199175)	(91)	(90)	(92)	(97)	(91)	**(86)**	(66)	1989
Severn Trent	Clywedog		44922	85	96	97	99	97	**95**	57	1989
	Derwent Valley	•	39525	98	96	86	94	80	**80**	43	1996
Yorkshire	Washburn	•	22035	97	90	78	90	82	**79**	50	1995
	Bradford supply	•	41407	96	94	85	95	82	**74**	38	1995
Anglian	Grafham		(55490)	(86)	(91)	(94)	(97)	(95)	**(89)**	(66)	1997
	Rutland		(116580)	(87)	(93)	(95)	(94)	(91)	**(87)**	(74)	1995
Thames	London	•	202340	92	94	94	94	93	**87**	73	1990
	Farmoor	•	13830	93	93	94	91	95	**89**	84	1990
Southern	Bewl		28170	92	92	90	86	79	**71**	45	1990
	Ardingly		4685	100	100	100	100	92	**77**	66	1995
Wessex	Clatworthy		5364	100	99	86	79	65	**55**	43	1992
	Bristol WW	•	(38666)	(97)	(96)	(91)	(88)	(79)	**(79)**	(53)	1990
South West	Colliford		28540	83	83	81	81	79	**76**	47	1997
	Roadford		34500	92	91	87	83	79	**75**	46	1996
	Wimbleball		21320	100	98	92	86	77	**68**	53	1992
	Stithians		5205	100	96	89	86	81	**76**	39	1990
Welsh	Celyn and Brenig	•	131155	99	98	94	100	98	**93**	65	1989
	Brianne		62140	97	95	88	100	94	**95**	67	1995
	Big Five	•	69762	98	95	86	96	87	**79**	41	1989
	Elan Valley	•	99106	99	96	87	99	89	**76**	63	1989
Scotland(E)	Edinburgh/Mid Lothian	•	97639	96	94	87	92	84	**76**	51	1998
	East Lothian	•	10206	98	96	95	91	82	**75**	72	1992
Scotland(W)	Loch Katrine	•	111363	95	89	87	88	84	**77**	53	2000
	Daer		22412	95	97	89	98	70	**74**	58	1994
	Loch Thom	•	11840	100	94	88	95	85	**85**	59	2000
Northern Ireland	Total+	•		96	94	80	93	89	**84**	54	1995
	Silent Valley	•	20634	92	93	79	95	92	**86**	42	2000

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

Details of the individual reservoirs in each of the groupings listed above are available on request. The featured reservoirs may not be representative of the storage conditions across each region; this can be particularly important during droughts. The minimum storage figures relate to the 1988-2003 period only (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.

Location map . . . Location map



National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology - IH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the Department of the Environment (NI). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

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

The National River Flow Archive (maintained by CEH Wallingford) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Rainfall

Most rainfall data are provided by The Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of The Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS*. Recent figures have been produced by The Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. An initiative is underway with The Met Office to provide more accurate areal figures and, since October 1999, to include more raingauges in the analysis. A significant number of additional monthly rainfall totals are currently being provided by the Environment Agencies. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.

*MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

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

Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

Hydrological Summaries
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Selected text and maps are available on the WWW at http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

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