Hydrological summary for the United Kingdom

March 2002

General

Overall, March was windy but mild, exceptionally so late in the month across most regions. Much of Scotland was wet but most of the rest of the UK reported a relatively dry month. Nonetheless, reservoir stocks increased modestly in most of the larger pumped storage reservoirs in the English Lowlands. Early April reservoir stocks were marginally above average for England and Wales as a whole (but still relatively low at Silent Valley in Northern Ireland). In water resources terms March can often be a pivotal month. Recent years have seen substantial reservoir and groundwater replenishment continue through the spring. This year, the exceptional dry interlude which began in the third week of March may - with evaporation demands accelerating through the late spring - signal an early onset of the seasonal recession in river flows and groundwater levels; much will depend on rainfall over next four weeks or so. Overall, water resources are healthy, groundwater especially so in many areas, but a rapid deterioration in the resources outlook has been a feature of several recent springs (e.g. 1995 and 1990). In the event of large rainfall deficiencies developing into the summer, the baseflow contribution to lowland river flow will be especially beneficial.

Rainfall

Westerly airflows were relatively rare in March, certainly in relation to the recent past, and those Atlantic frontal systems which did cross the British Isles generally followed a track remote from southern England. This synoptic backcloth tended to reinforce the normal north-west/south-east rainfall gradient across the country. Early in the month weather patterns were very unsettled in Scotland – a humid airflow produced torrential rain in the West Highlands on the 6th (a 24 hr total of 93 mm was reported for Sloy) but dry conditions characterised central and southern Britain where the great majority of the March rainfall occurred between the 9th and 22nd. Thereafter high pressure dominated resulting in very meagre precipitation totals over the ensuing three weeks - in some districts (e.g. in central southern England) fog-drip provided the only contribution. Provisional March rainfall totals were low (<60%) in parts of eastern Scotland but notably high in a few parts of the central Highlands. Northern Ireland registered its seventh successive March with below average rainfall. England and Wales reported below average rainfall for all regions with very modest rainfall in south – a few localities (e.g. in parts of Gloucestershire) recording <40% of the 1961-90 average. Provisional data suggest that Scotland had its fourth wettest Jan-March period in a series from 1862. More significantly from a water resources perspective, winter half-year (Oct-Mar) rainfall totals are within the normal range throughout the UK.

River Flows

The month began with most rivers in brisk recession, and a corresponding reduction in flood risk. Runoff rates recovered in the second week in Scotland and short-lived spates were common in mid-month in southern England - the River Mole reported a new maximum March flow on the 18th. Generally steep recessions had become re-established by month end and continued well into April – by the second week flows were seasonally depressed in many impermeable catchments (e.g the Severn and Welsh Dee basins). Runoff totals for March showed wide spatial variations (in part due to contrasts between neighbouring impermeable and permeable catchments) but were mostly well within the normal range. Runoff totals for the year thus far are within the normal range for almost all index catchments. This is also true for the winter half-year (Oct-Mar), but in much of Scotland winter runoff was again substantially above average – for the 6th successive year in some catchments; this clustering reinforces the flow regime contrasts between the recent past and the 1970s and early 1980s.

Groundwater

High temperatures, abetted in many areas by very windy conditions, resulted in above average evaporative demands across most major aquifer outcrop areas in March. As a consequence, soil moisture deficits increased briskly, particularly from mid-month, and were well above average approaching mid-April. In the absence of a wet late spring this may be expected to signal an early end to the 2001/02 recharge season across much of the English Lowlands. Declines in groundwater levels are already evident in the more responsive Chalk wells (e.g. Rockley and Chilgrove), whilst levels continue to rise in the less responsive and/or deeper wells in the east especially. In the Chalk, seasonal recessions have begun from very much lower levels than last year – but still above the early spring average in most outcrop areas. March groundwater levels were close to the seasonal average in most major limestone aquifers. By contrast, in large parts of the slow-responding Permo-Triassic sandstones groundwater levels remain appreciably above pre-2000 maxima (e.g in North Wales and the North West). Overall groundwater resources remain above average, as do spring outflows in most areas.

Centre for Ecology & Hydrology
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Rainfall accumulations and return period estimates

Area	Rainfall	Mar 2002	Jan02-Mar02	RP	Oct01-Mar02	RP	Jul01-Mar02	RP	Apr01-Mar02	RP
England & Wales	**mm**	**53**	**252**		**497**		**734**		**923**	
	%	**72**	**110**	**2-5**	**98**	**2-5**	**102**	**2-5**	**101**	**2-5**
North West	mm	61	414		742		1028		1252	
	%	64	141	10-20	111	2-5	105	2-5	104	2-5
Northumbrian	mm	54	272		501		719		880	
	%	77	128	5-10	110	2-5	106	2-5	103	2-5
Severn Trent	mm	35	207		400		601		788	
	%	58	112	2-5	101	2-5	103	2-5	104	2-5
Yorkshire	mm	43	221		425		643		819	
	%	63	108	2-5	96	2-5	100	<2	100	<2
Anglian	mm	35	134		290		515		668	
	%	74	100	<2	97	2-5	114	5-10	112	5-10
Thames	mm	43	198		384		577		727	
	%	77	120	2-5	106	2-5	109	2-5	105	2-5
Southern	mm	46	224		429		641		761	
	%	74	114	2-5	97	2-5	104	2-5	98	2-5
Wessex	mm	53	257		477		657		796	
	%	75	116	2-5	100	<2	98	2-5	95	2-5
South West	mm	77	392		692		880		1054	
	%	77	116	2-5	96	2-5	91	2-5	90	2-5
Welsh	mm	64	443		839		1133		1371	
	%	60	128	5-10	108	2-5	106	2-5	104	2-5
Scotland	**mm**	**124**	**566**		**1012**		**1309**		**1501**	
		99	**150**	**50-80**	**121**	**10-20**	**110**	**2-5**	**104**	**2-5**
Highland	mm	165	710		1299		1631		1882	
	%	102	149	35-50	121	5-15	110	2-5	107	2-5
North East	mm	61	286		594		851		989	
	%	78	118	2-5	112	2-5	109	2-5	102	2-5
Tay	mm	114	535		897		1160		1319	
	%	105	154	30-45	124	5-15	115	5-10	107	2-5
Forth	mm	98	439		733		973		1136	
	%	104	151	30-45	117	5-10	107	2-5	102	2-5
Tweed	mm	65	362		617		840		1009	
	%	82	147	20-30	117	5-10	108	2-5	104	2-5
Solway	mm	91	544		933		1222		1436	
	%	77	145	20-30	113	2-5	104	2-5	101	2-5
Clyde	mm	157	697		1198		1559		1791	
	%	107	154	50-80	119	5-10	109	2-5	106	2-5
Northern Ireland	**mm**	**66**	**352**		**604**		**813**		**1000**	
	%	**75**	**127**	**5-10**	**101**	**2-5**	**95**	**2-5**	**94**	**2-5**

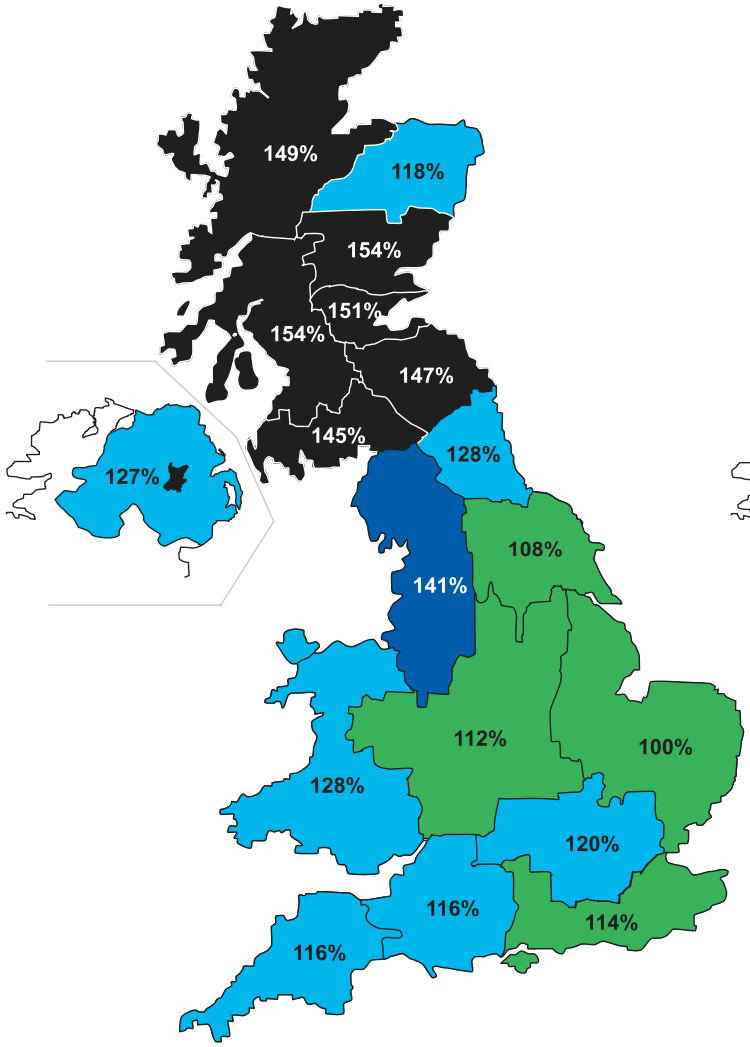
RP = Return period

 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.

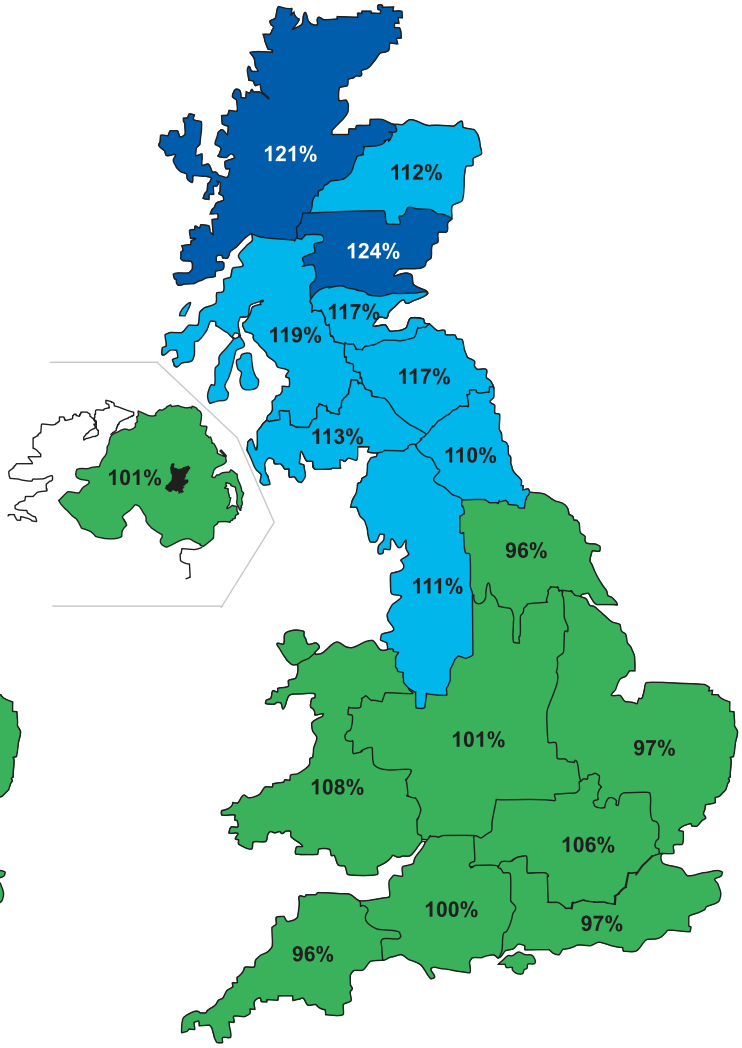
Rainfall . . . Rainfall . . . Rainfall

Key

00%	Percentage of 1961-90 average		Normal range
	Very wet		Below average
	Substantially above average		Substantially below average
	Above average		Exceptionally low rainfall



January 2002 - March 2002

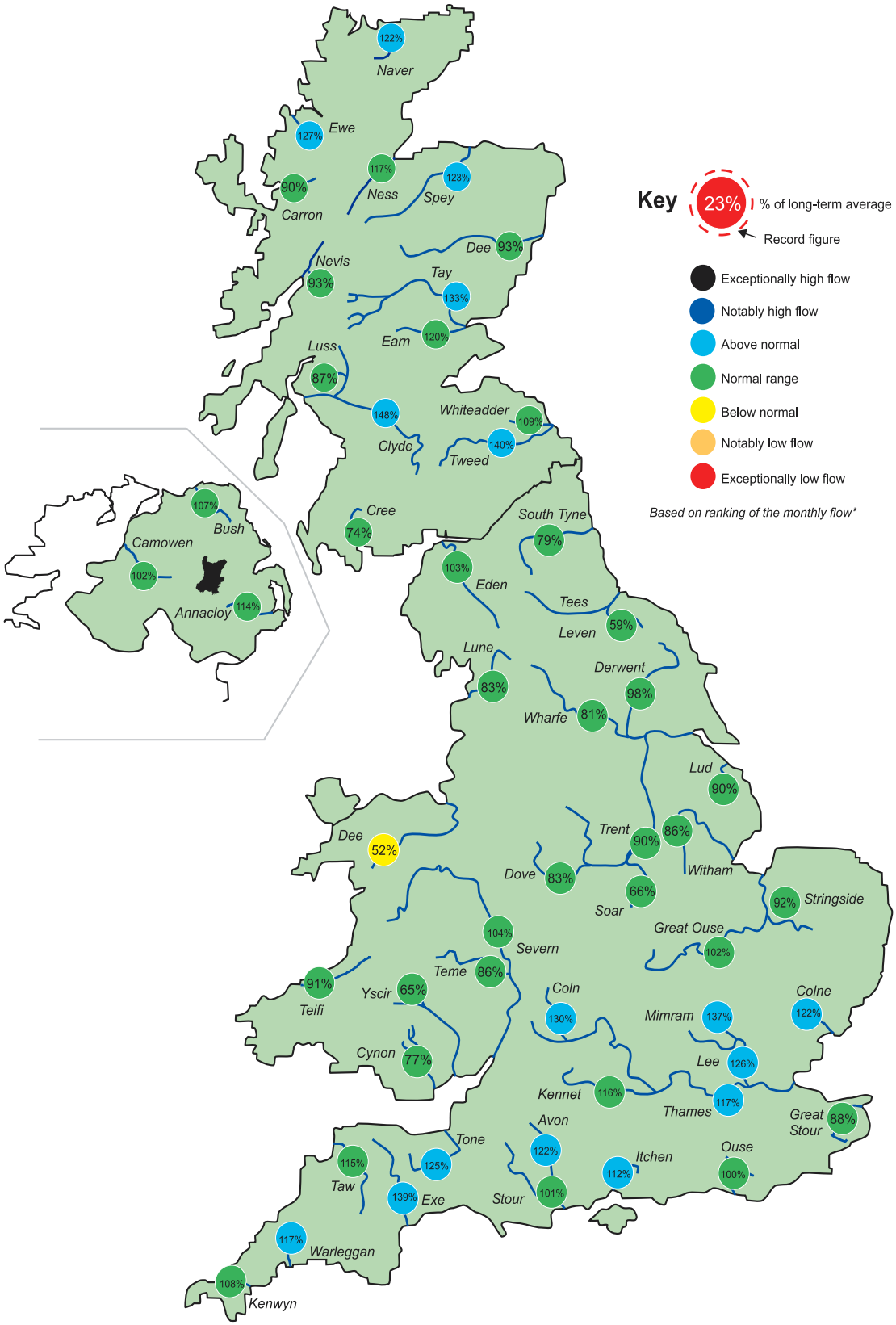


October 2001 - March2002

Rainfall accumulation maps

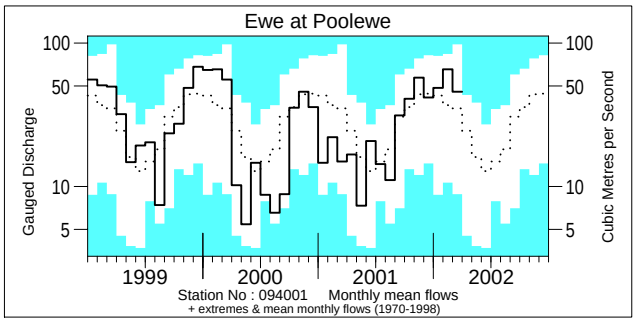
The provisional Jan-March rainfall total for Britain ranks amongst the wettest ten in a 134-year series (1988, 1989, 1990, 1994 and 1995 also feature in this group). For Scotland the six-month rainfall total is also notable; elsewhere the Oct-Mar regional rainfall totals were close to the 1961-90 average. In the 12-month timeframe almost all regional totals for the UK are within 10% of the mean.

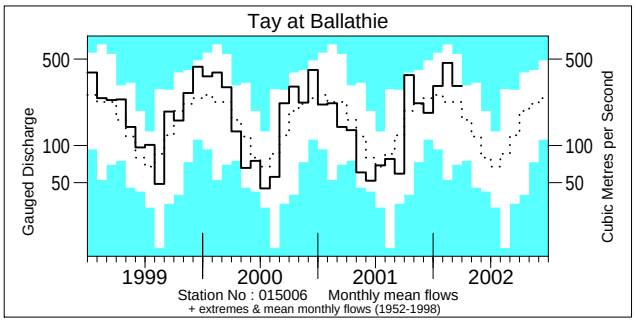
River flow . . . River flow . . .

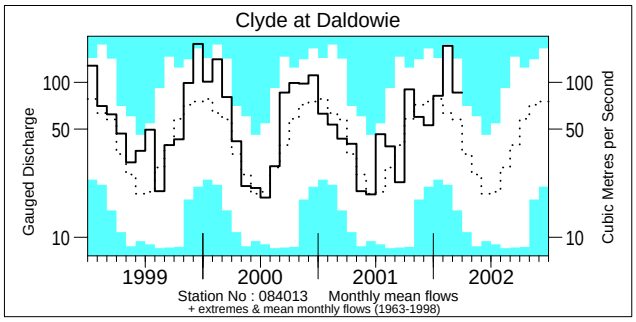


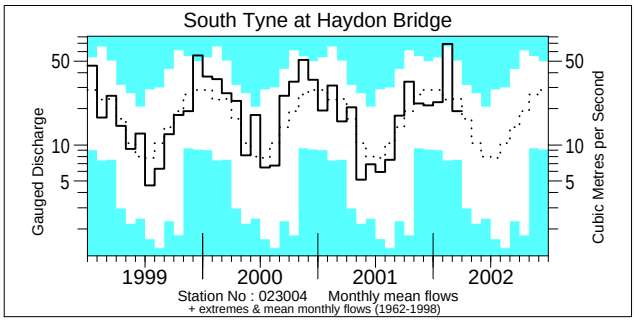
River flows - March 2002

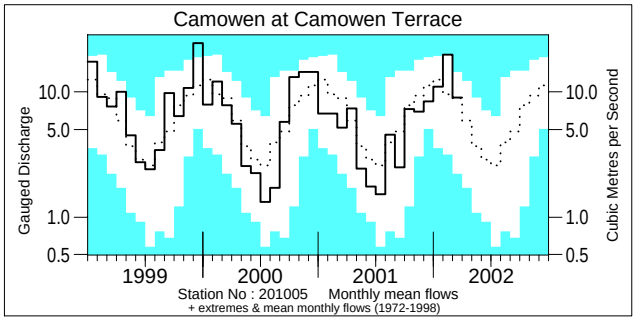
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

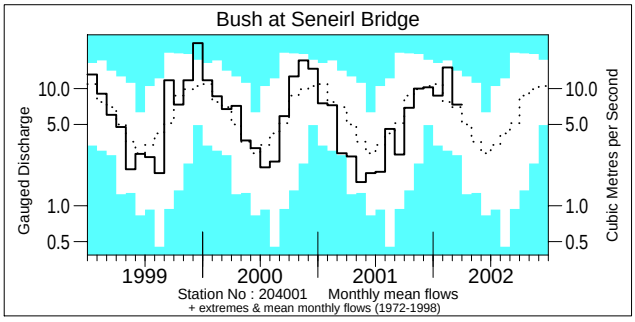


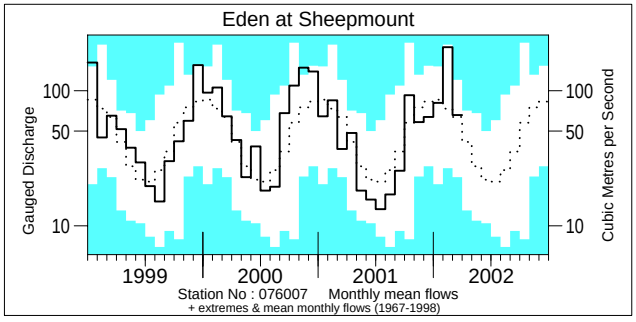


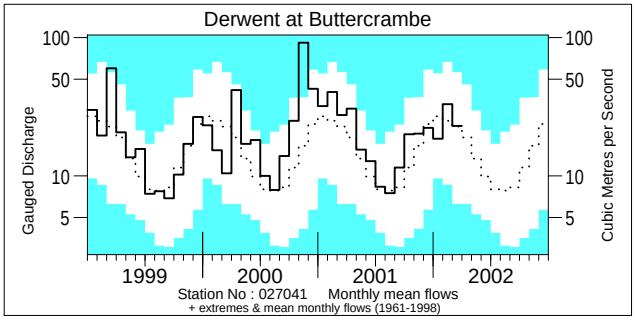


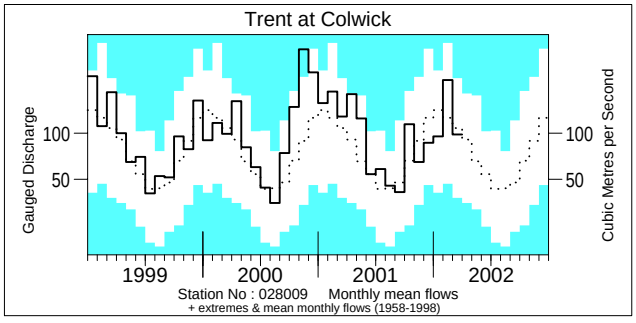


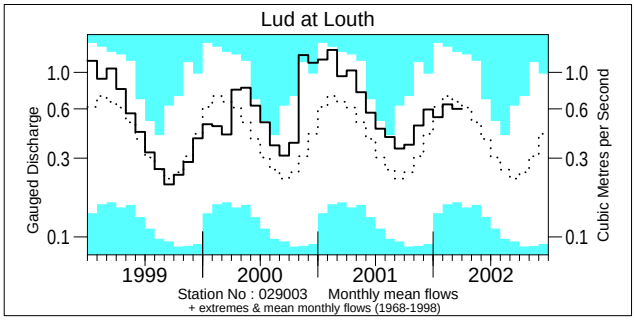








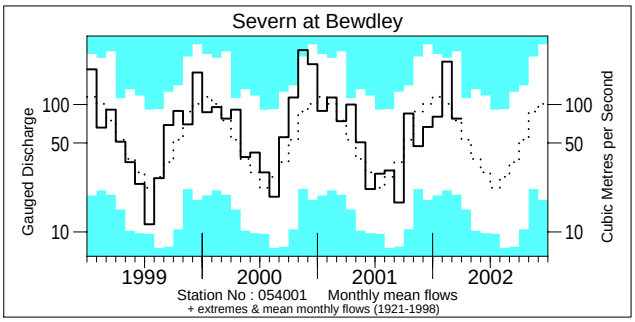


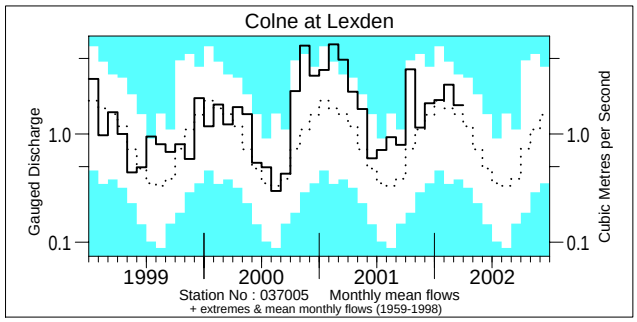


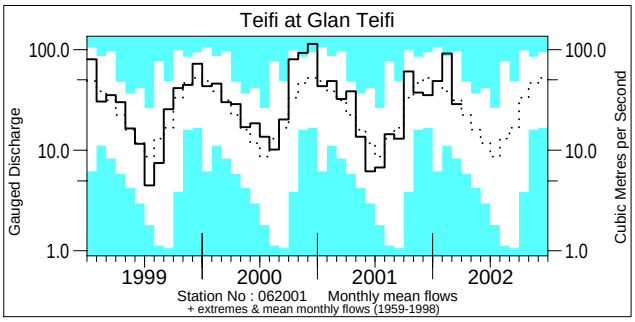
Monthly river flow hydrographs

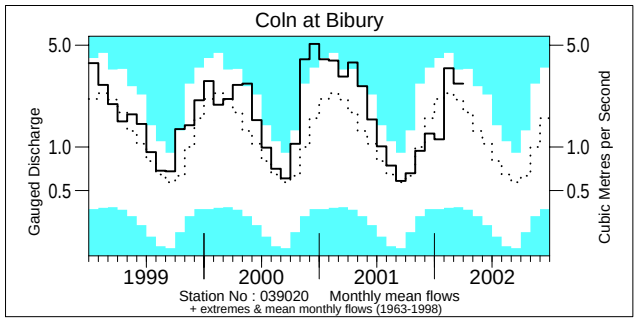
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1999 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded areas.

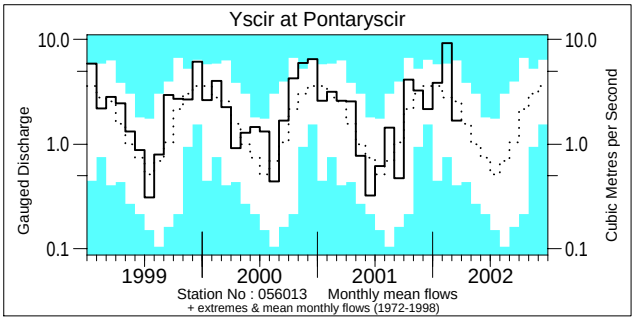
River flow . . . River flow . . .

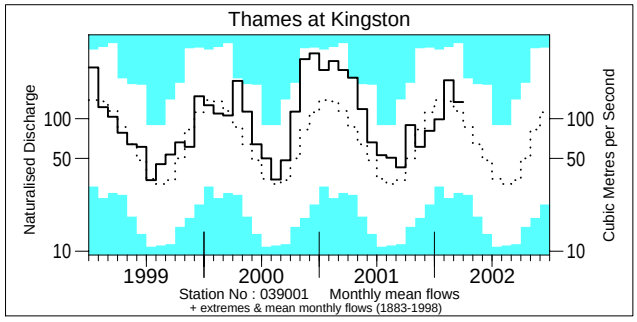


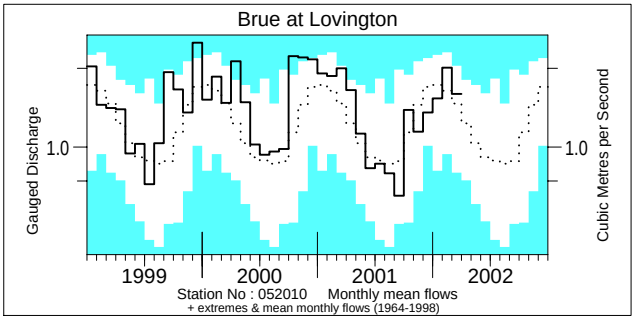


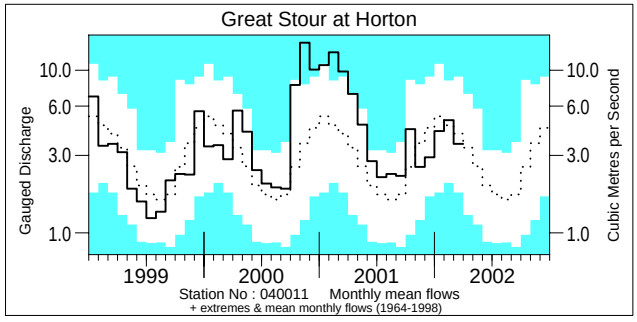


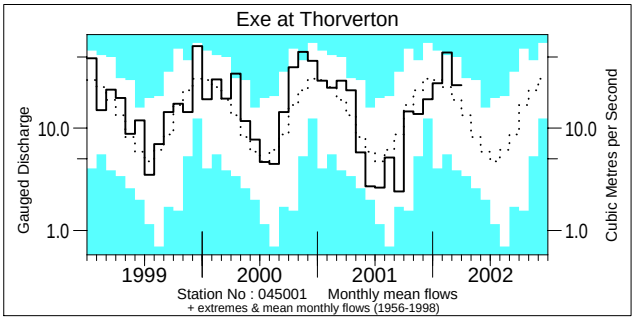


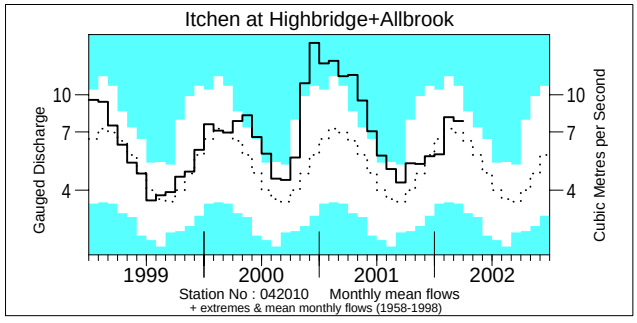












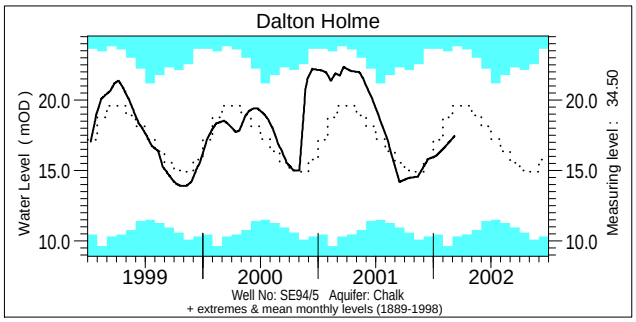
Notable runoff accumulations (a) January 2002 - March 2002, (b) October 2001 - March 2002

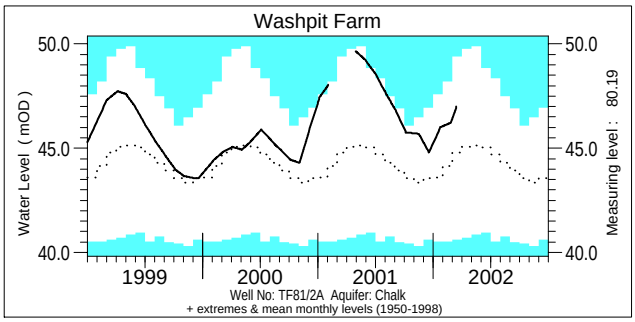
	River	%lta	Rank	River	%lta	Rank
(a)	Spey	133	47/50	Cynon	164	43/44
	Tay	147	48/50	Dee	150	64/65
	Tweed	144	39/42	Lune	157	40/42
	S Tyne	138	38/40	Eden	151	33/35
	Wharfe	143	46/47	Clyde	161	38/39
	Mole	132	24/28	Naver	154	25/25
	Exe	143	44/46	Camowen	126	24/29
	Yscir	156	30/30			

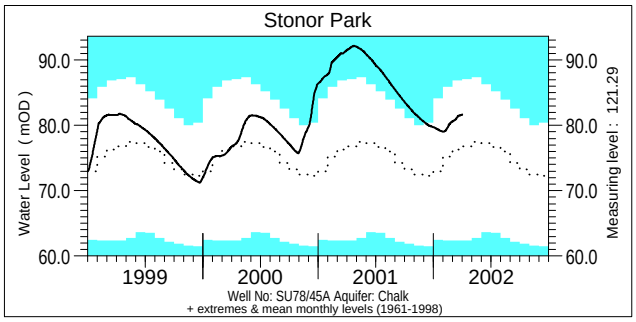
	River	%lta	Rank
(b)	Deveron	136	36/40
	Mimram	145	44/48
	Kenwyn	71	3/34
	Leven(Glasgow)	129	37/38
	Carron	122	21/23
	Ness	122	24/29

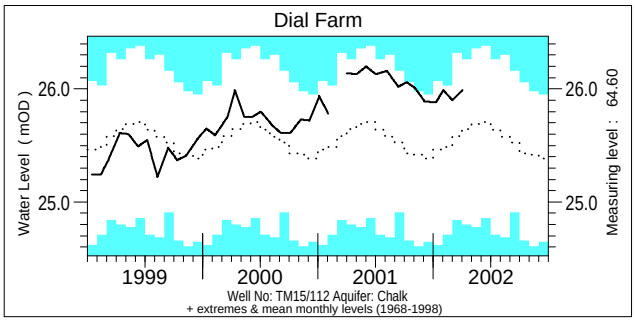
lta = long term average
Rank 1 = lowest on record

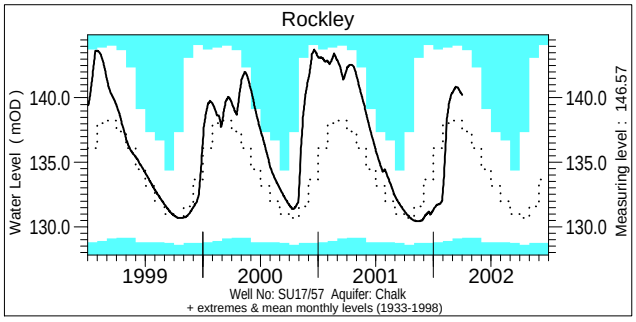
Groundwater…Groundwater

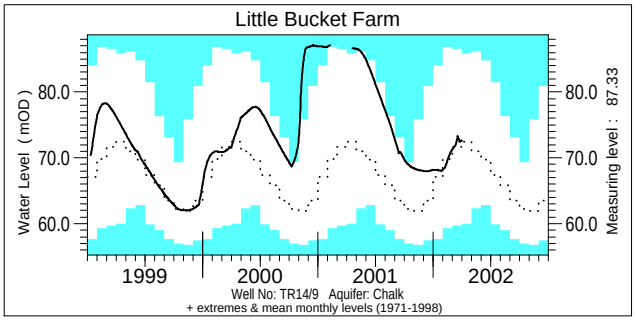


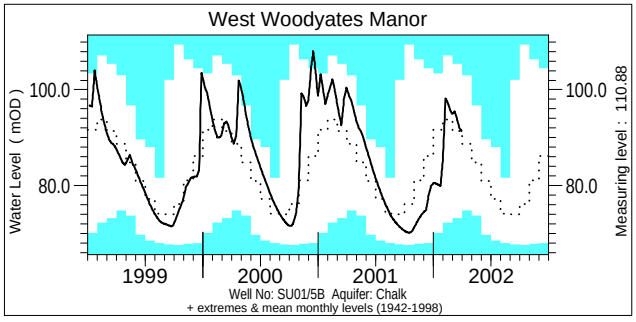


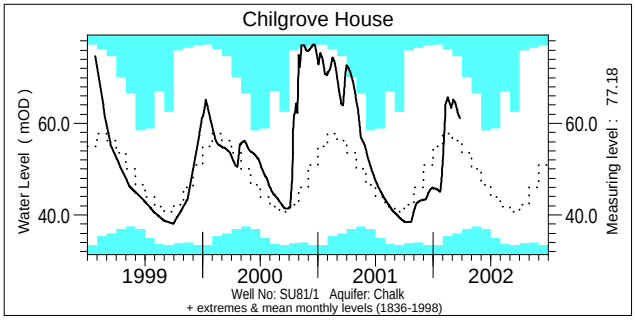


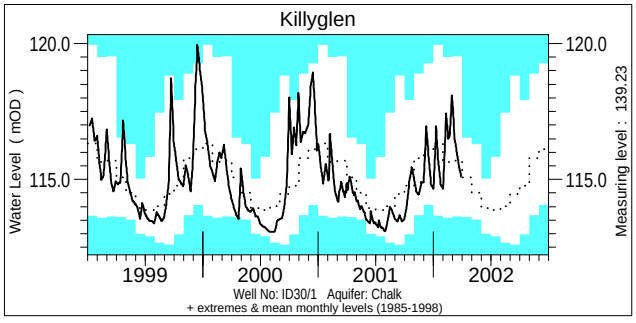


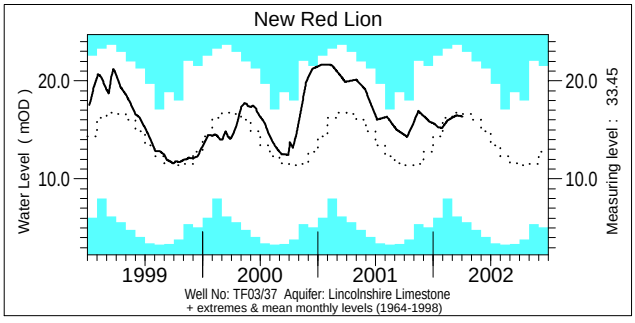






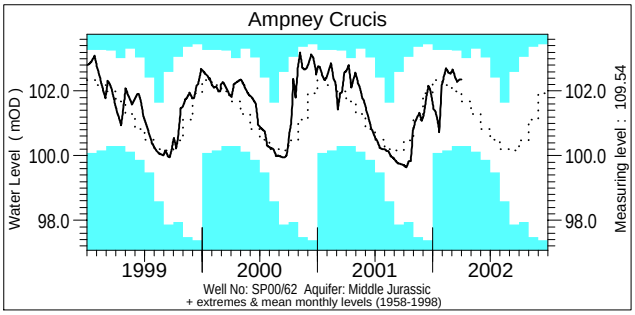


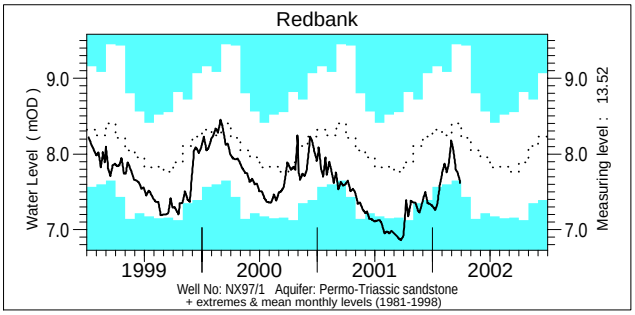


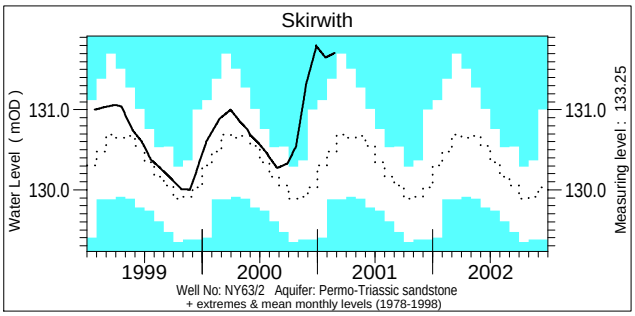


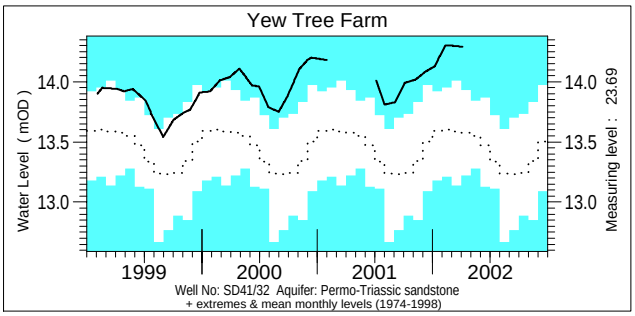
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

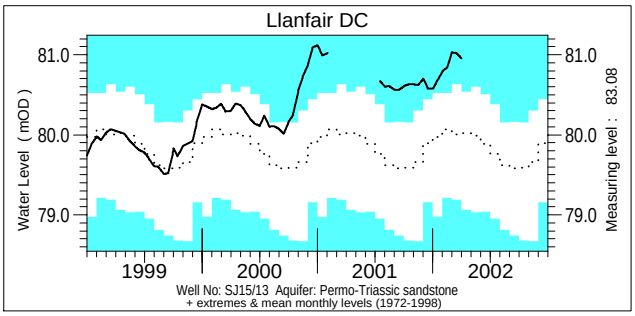
Groundwater . . . Groundwater

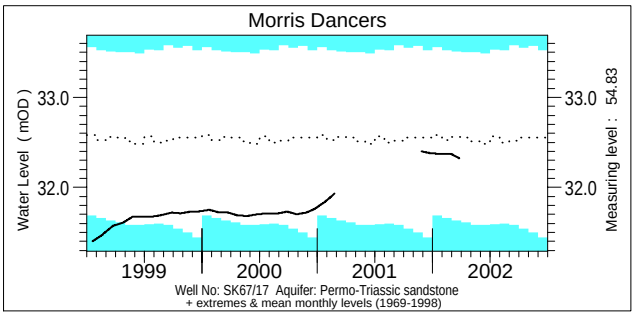


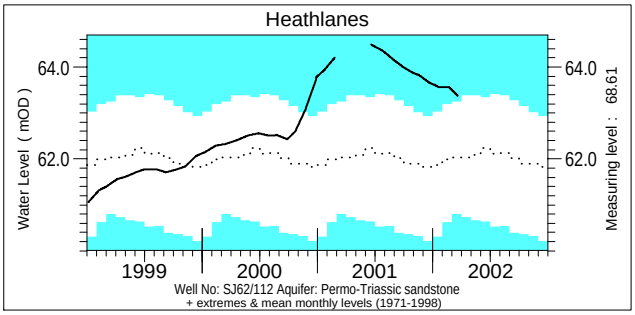


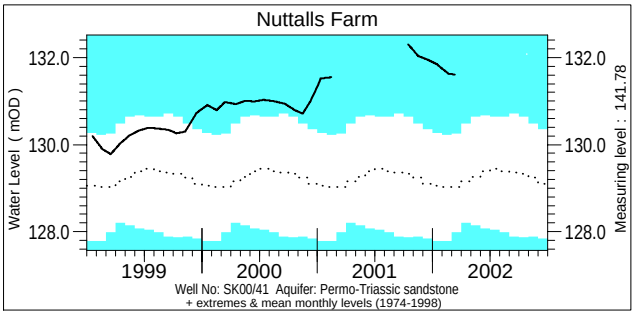


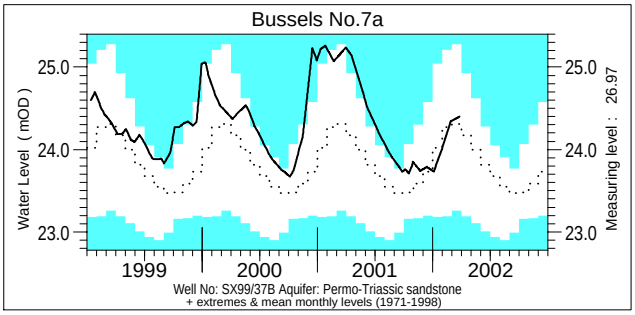


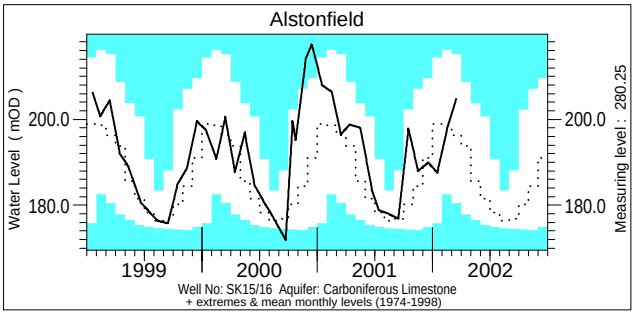












Groundwater levels March 2002 / April 2002

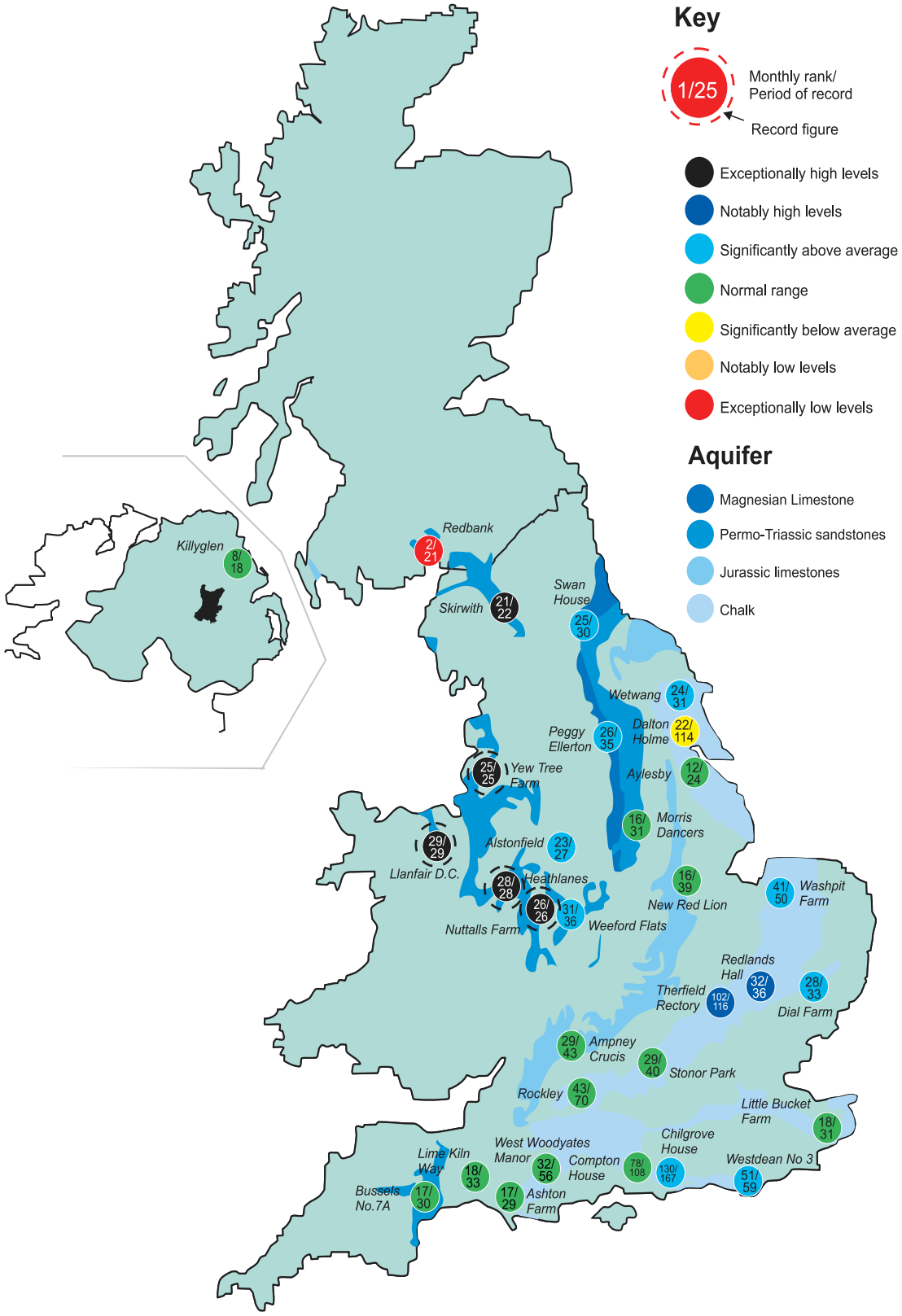
Borehole	Level	Date	Mar. av.
Dalton Holme	17.47	08/03	19.52
Washpit Farm	46.99	14/03	44.86
Stonor Park	81.65	02/04	76.82
Dial Farm	25.99	02/04	25.58
Rockley	140.24	02/04	138.41
Little Bucket Farm	72.67	31/03	71.80
West Woodyates	91.39	31/03	90.75

Borehole	Level	Date	Mar. av.
Chilgrove House	61.11	25/03	55.52
Killyglen	115.11	28/03	115.65
New Red Lion	16.36	03/04	16.67
Ampney Crucis	102.35	02/04	102.03
Redbank	7.62	28/03	8.36
Skirwith	131.13	22/03	130.65
Yew Tree Farm	14.29	05/04	13.60

Borehole	Level	Date	Mar. av.
Llanfair DC	80.95	01/04	79.96
Morris Dancers	32.32	26/03	32.40
Heathlanes	63.37	20/03	61.97
Nuttalls Farm	131.61	12/03	129.25
Bussels No.7a	24.40	25/03	24.34
Alstonfield	204.73	15/03	196.24

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



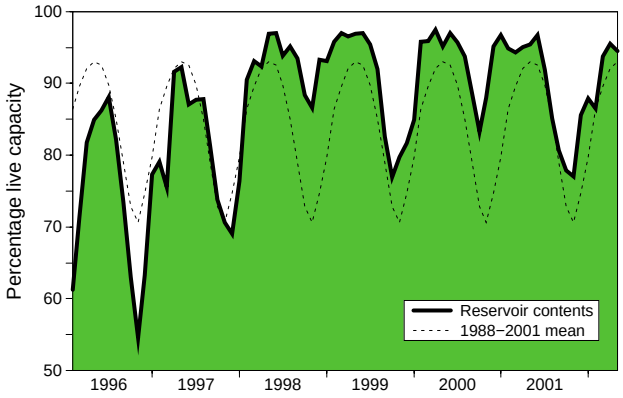
Groundwater levels - March 2002

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.

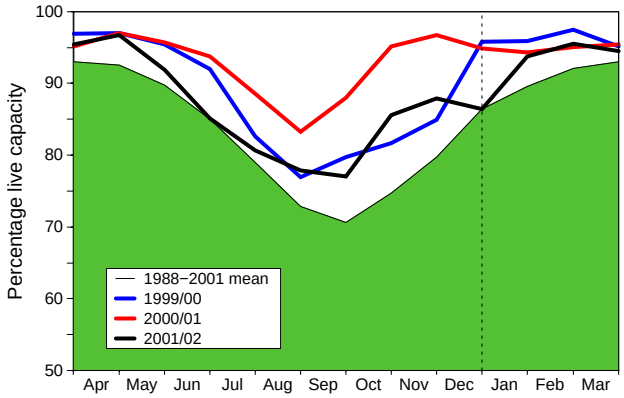
(Note: Redbank is affected by groundwater abstraction)

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.

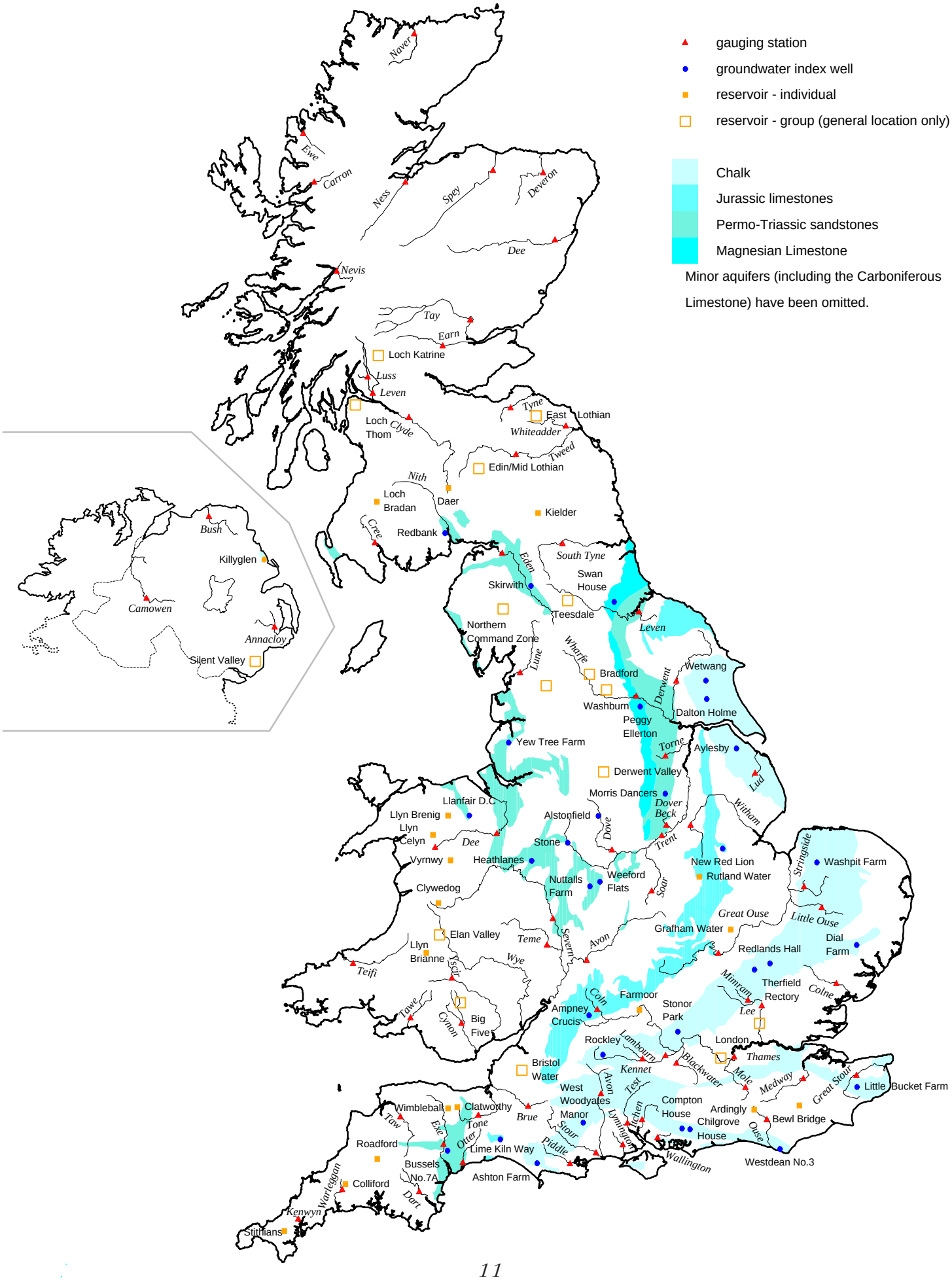
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2001 Nov	Dec	2002 Jan	Feb	Mar	Apr	Min. Apr	Year* of min
North West	N Command Zone	• 124929	75	84	84	100	100	97	77	1993
	Vyrnwy	55146	86	91	88	100	100	100	64	1996
Northumbrian	Teesdale	• 87936	96	83	84	99	100	97	77	1996
	Kielder	(199175)	(80)	(95)	(89)	(100)	(96)	(92)	81	1993
Severn Trent	Clywedog	44922	73	100	87	96	100	94	86	1996
	Derwent Valley	• 39525	99	86	100	100	100	98	54	1996
Yorkshire	Washburn	• 22035	89	92	91	95	97	91	70	1996
	Bradford supply	• 41407	86	90	90	99	100	96	59	1996
Anglian	Grafham	(55490)	(93)	(88)	(88)	(87)	(87)	(89)	77	1997
	Rutland	(116580)	(80)	(81)	(82)	(84)	(89)	(92)	74	1992
Thames	London	• 202340	90	87	86	87	88	92	88	1990
	Farmoor	• 13830	92	91	77	79	88	87	84	1992
Southern	Bewl	28170	74	74	75	90	97	98	58	1989
	Ardingly	4685	72	73	86	100	100	100		
Wessex	Clatworthy	5364	67	72	84	97	100	100	82	1992
	Bristol WW	• (38666)	(61)	(59)	(61)	(70)	(99)	(98)	71	1992
South West	Colliford	28540	60	62	64	72	78	82	58	1997
	Roadford	34500	73	73	72	84	94	94	37	1996
	Wimbleball	21320	52	54	58	76	100	100	78	1996
	Stithians	5205	32	29	33	49	78	88	52	1992
Welsh	Celyn and Brenig	• 131155	94	97	94	100	100	98	72	1996
	Brianne	62140	100	100	94	100	98	97	90	1993
	Big Five	• 69762	97	95	93	99	97	94	78	1993
	Elan Valley	• 99106	100	100	99	100	100	97	89	1993
East of Scotland	Edinburgh/Mid Lothian	• 97639	89	90	89	92	100	98	71	1998
	East Lothian	• 10206	97	100	100	100	100	100	95	1990
West of Scotland	Loch Katrine	• 111363	85	93	88	99	100	99	88	2001
	Daer	22412	91	100	97	100	100	100	93	2001
	Loch Thom	• 11840	84	93	93	100	100	98	93	2001
Northern Ireland	Silent Valley	• 20634	54	43	39	46	57	59	57	2000

() figures in parentheses relate to gross storage • denotes reservoir groups * 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 1988-2002 period only (except for West of Scotland and Northern Ireland where data commence in 1994 and 1993 respectively). 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 regional divisions of the EA (England and Wales) and SEPA (Scotland), data for Northern Ireland are provided by 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, the West of Scotland and East of Scotland Water Authorities, 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 (address 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; over the coming months further monthly raingauge totals will be included for selected regions. Until the access to these additional data has stabilised the regional figures (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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RG12 2SY
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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
National Water Archive
CEH Wallingford
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
Tel.: 01491 838800
Fax: 01491 692424

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

NATURAL ENVIRONMENT RESEARCH COUNCIL

3/02