Hydrological Summary
for the United Kingdom

December 2003

General

Rainfall in December was only marginally above average for the UK but, as usual in the early winter, wet soil conditions ensured that it was hydrologically effective. Correspondingly, river flows – and subsequently flood risk – increased through the month and whilst generally below average, most runoff totals were well within the normal December range. December levels in some reservoirs remained seasonally depressed (e.g. Ardingly, Lothian Region) but, aided in some areas by Drought Permits (e.g. Farmoor), some impoundments reported increases of >25%. Entering 2004, overall reservoir stocks for England and Wales were about 6% below average, having increased by around 19% through December - the largest single monthly increase in the 1988-2004 series. Healthy recoveries were also reported for a number of major Scottish reservoirs. Nationally, the last 10 weeks has seen a substantial moderation in drought severity but the improvement in the resources outlook has been uneven. Rainfall deficiencies increased during December in some areas (e.g. parts of Yorkshire and the South-West) and in some important aquifer outcrop areas the much-belated seasonal recoveries in groundwater levels requires above average late winter rainfall to maintain its momentum. More generally, the water resources prospects for summer 2004 will be considerably influenced by the timing of the onset of the seasonal recession in runoff and recharge rates – in this context, a wet early spring would be most beneficial.

Rainfall

December was a very mixed bag in weather terms with frontal incursions from many points of the compass alternating with stable anticyclonic interludes. A wide range of precipitation types – from fog-drip to snow – was reported even in southern Britain. However, the very damp complexion to the weather, from mid-month especially, often failed to translate into substantial daily rainfall totals. Exceptions included 36 mm on the Isle of Wight on the 1st and 80 mm in 18 hrs at Shap Fell in the Lake District (26th) – both very useful storms in a water resources context. A few localities (e.g. Belfast) reported December rainfall totals below 70% but most catchments registered between 85% and 120% of average; the majority of regional totals were slightly above average. Despite the modest recent reduction in regional rainfall deficiencies the provisional Feb-Dec total for Britain is the third lowest since 1933. The drought remains notable in this timeframe – especially in the North-East; parts of Yorkshire recorded above average rainfall for only two months in 2003 (a distinction shared with parts of the Midlands and central southern England). After five wet years, the 2003 rainfall total for England and Wales is the lowest annual rainfall total since 1975; over the same timespan, the totals for Scotland and Northern Ireland rank lowest and second lowest respectively.

River Flow

In most regions, river flows recovered erratically through December but, by year-end, spates were common and in some areas flood risk was increasing. However, the Naver was the only index river to register an above average December mean flow. Generally runoff totals were between 50-80% of average - mostly well within the normal range and considerable greater than drought minima (for December). The water resources stress evident over recent months is principally a reflection of the modest runoff since January 2003. This is emphasised by the runoff deficiencies for the Feb-Dec period, which for impermeable catchments, commonly exceed 40%. Index gauging stations establishing new period-of-record minima over this timespan show a wide distribution - including the Aberdeenshire Dee (in a 74-yr record), the Taw and, in Northern Ireland, the Annacloy. The importance of groundwater to river flows, in the English Lowlands especially, is emphasised by the above average runoff over the same period for a number of spring-fed streams (including the Mimram and Itchen). Baseflow contributions had generally declined greatly by early December but may be expected to recover appreciably in early 2004.

Groundwater

The well-distributed December rainfall ensured that by month end areas with significant soil moisture deficits were restricted to a few low-lying eastern areas (e.g the Vale of York, and inland from the Wash). Elsewhere, significant but mostly below average infiltration characterised the outcrop areas of the major aquifers. A significant proportion of index wells reported too early in December to fully capture the consequent groundwater level recovery but notable rises were reported for a number of responsive aquifer units (particularly in the limestone aquifers, but in the IoW Chalk also). The upturn in the southern Chalk is especially welcome and most Chalk levels are now within the normal range – albeit still low for the early winter. Even in the normally late-responding eastern aquifer units (e.g. the Essex Chalk), and in the minor aquifers (e.g. Suffolk Crag) modest rises have been recorded. In the context of the abundant 1998-2002 recharge, the paucity of recent infiltration to the slowest responding Permo-Triassic sandstones outcrops is of limited significance – most index wells remain above average, some notably so. Near-saturated soils will ensure further significant infiltration in January but, commonly, recoveries are being generated from a very low base and the window of opportunity for further replenishment could be narrow (in the event of a dry late winter).

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

Rainfall accumulations and return period estimates

Area	Rainfall	Dec 2003	Nov 03-Dec 03	RP	Aug 03-Dec 03	RP	Feb 03-Dec 03	RP	Jan 03-Dec 03	RP
England & Wales	**mm**	**100**	**217**		**341**		**679**		**770**	
	%	**106**	**115**	**2-5**	**79**	**5-10**	**83**	**5-15**	**84**	**5-15**
North West	mm	139	248		404		857		955	
	%	112	100	<2	68	15-25	79	10-20	79	10-20
Northumbrian	mm	95	154		272		556		643	
	%	117	92	2-5	69	10-20	72	30-50	75	30-40
Severn Trent	mm	86	140		236		529		590	
	%	112	94	2-5	69	10-20	77	10-20	78	10-20
Yorkshire	mm	83	145		268		596		665	
	%	100	89	2-5	71	10-20	80	10-20	81	10-20
Anglian	mm	63	136		207		457		527	
	%	115	120	2-5	77	5-10	84	5-10	88	2-5
Thames	mm	70	181		248		479		559	
	%	100	134	5-10	79	5-10	77	10-20	81	5-15
Southern	mm	88	227		315		546		631	
	%	107	136	5-10	85	2-5	78	10-20	81	5-15
Wessex	mm	98	211		294		589		676	
	%	105	120	2-5	75	5-10	78	5-15	81	5-15
South West	mm	139	247		392		838		938	
	%	100	94	2-5	70	5-15	81	5-15	80	10-20
Welsh	mm	155	283		458		952		1066	
	%	101	96	2-5	71	10-20	81	5-15	81	10-20
Scotland	**mm**	**167**	**324**		**529**		**1022**		**1190**	
	%	**111**	**107**	**2-5**	**74**	**15-25**	**79**	**30-40**	**83**	**15-25**
Highland	mm	221	395		668		1254		1483	
	%	112	99	2-5	75	10-20	80	20-30	84	10-20
North East	mm	114	192		347		642		756	
	%	123	100	<2	75	10-20	73	50-80	78	30-40
Tay	mm	127	275		388		825		952	
	%	100	111	2-5	66	20-30	76	20-30	77	20-30
Forth	mm	115	226		360		746		858	
	%	105	102	2-5	66	20-35	75	30-50	77	30-40
Tweed	mm	100	181		301		637		739	
	%	108	97	2-5	66	20-35	73	30-50	76	30-40
Solway	mm	155	351		510		1035		1165	
	%	105	120	2-5	72	10-20	82	10-20	82	10-20
Clyde	mm	184	403		631		1239		1409	
	%	103	112	2-5	73	10-20	82	10-20	83	10-20
Northern Ireland	**mm**	**90**	**209**		**351**		**809**		**902**	
	%	**86**	**101**	**2-5**	**69**	**10-20**	**85**	**5-10**	**85**	**5-10**

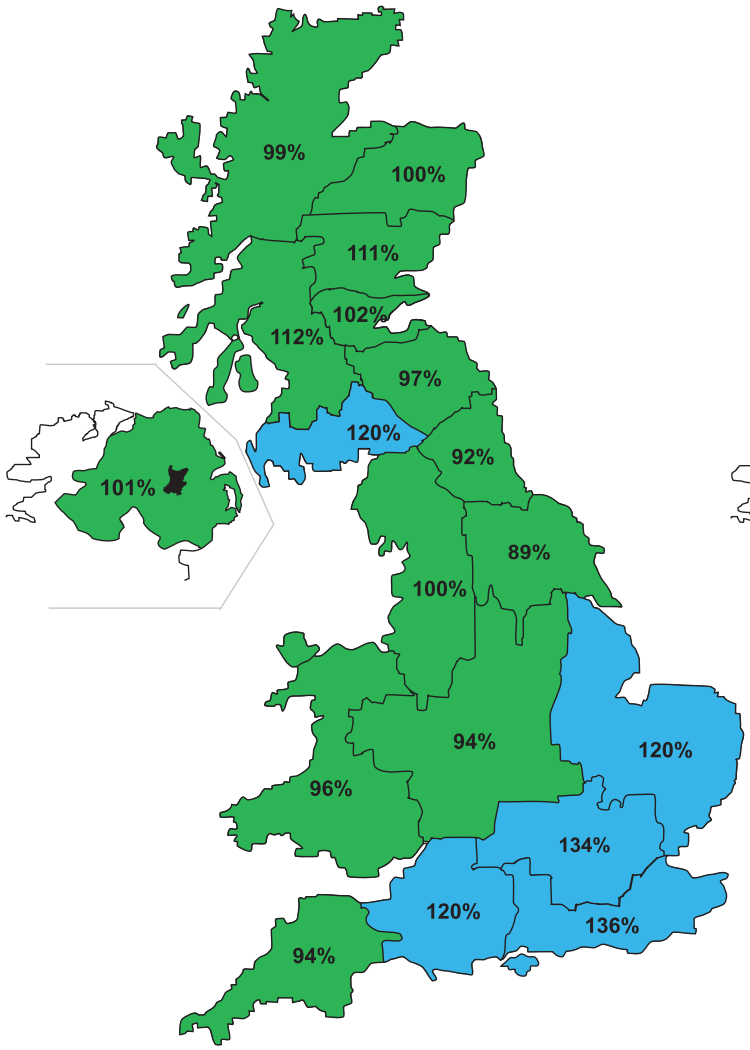
RP = Return period

 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.

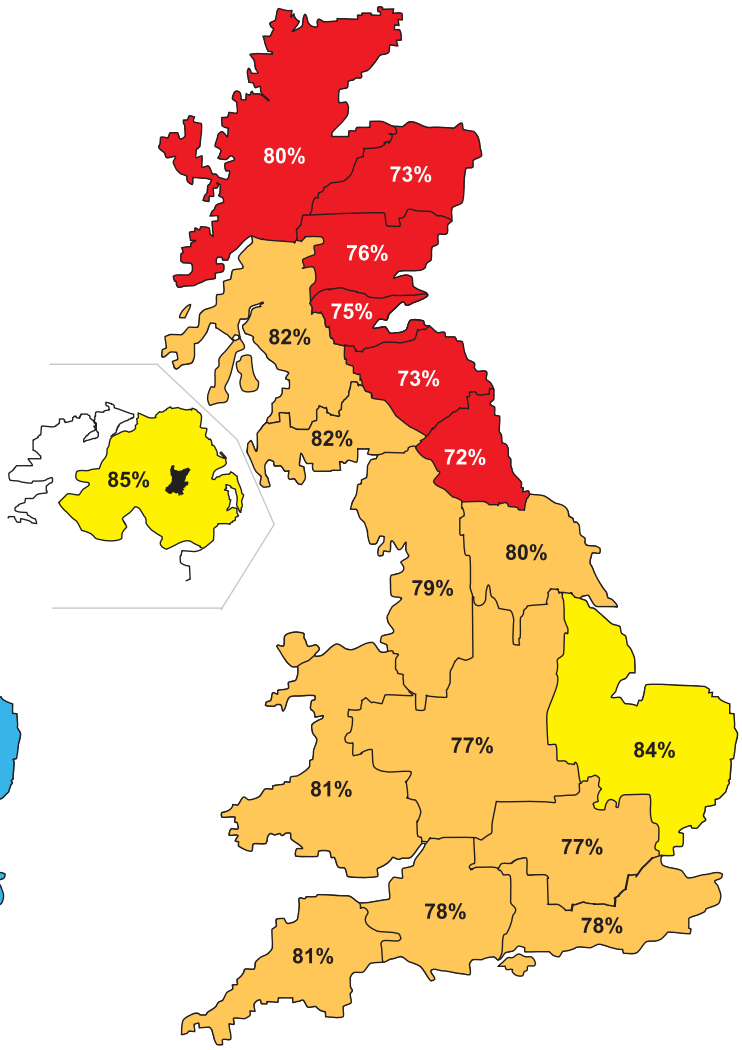
Rainfall . . . Rainfall . .

Key

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



November 2003 - December 2003

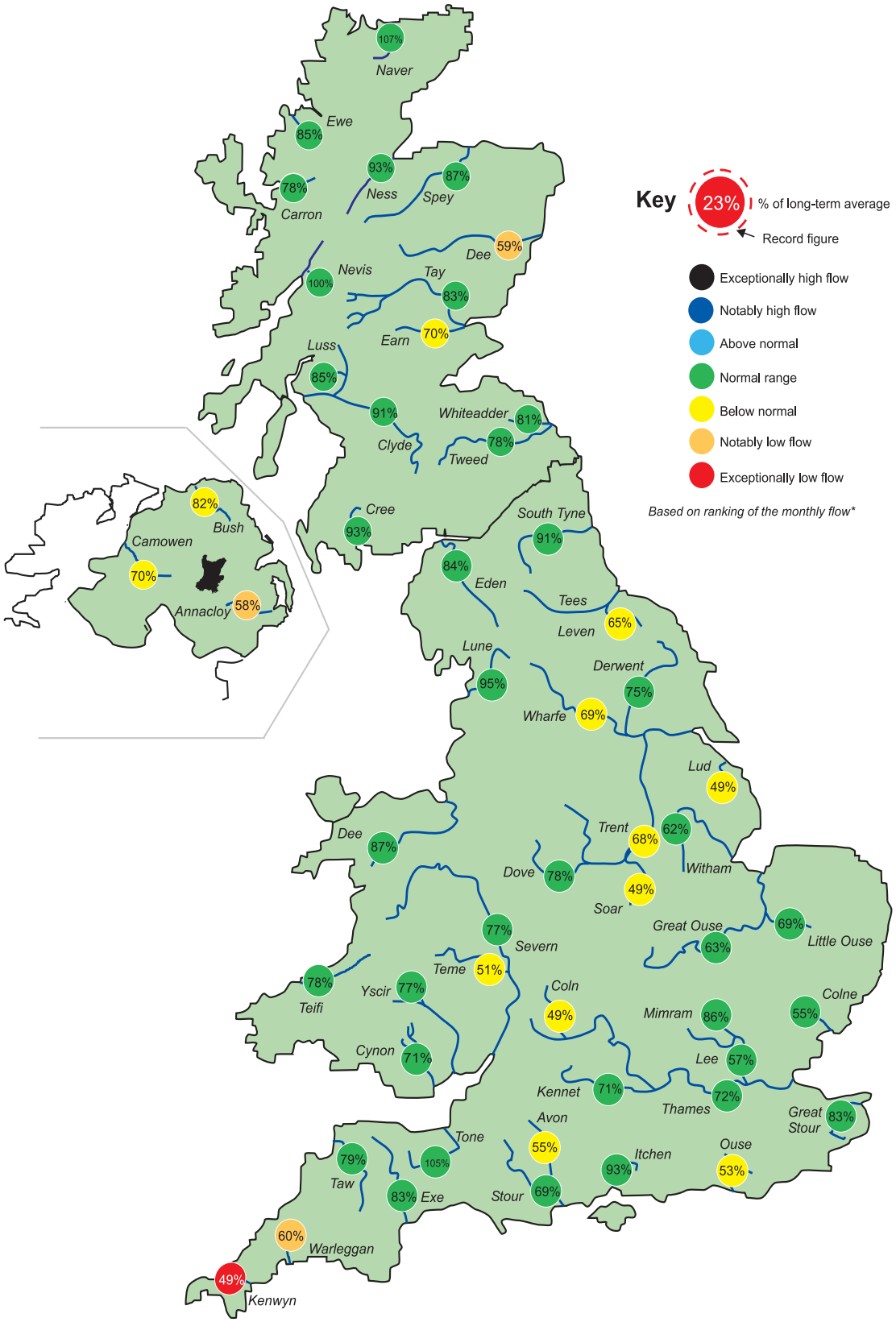


February 2003 - December 2003

Rainfall accumulation maps

The combined November and December rainfall for the UK as a whole was marginally above average - sufficient to moderate but not terminate the drought in most regions. Over the 11-month timespan the provisional UK rainfall total is the 4th lowest in the last 100 years and substantial rainfall deficiencies persist in all regions. (Note: the resilience of water supply provision in the UK is such that only a proportion of the accumulated rainfall deficiency needs to be satisfied in order to greatly improve the water resources outlook.)

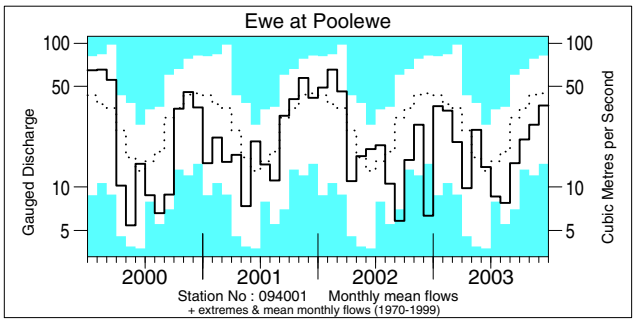
River flow . . . River flow . . .

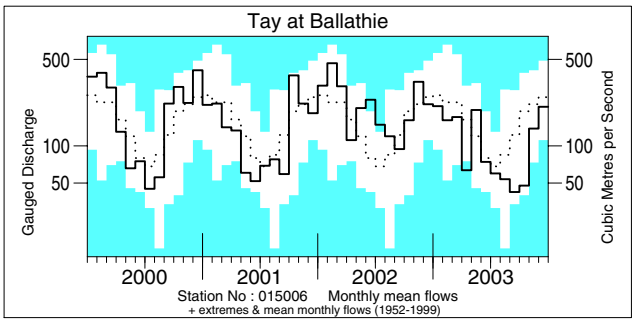


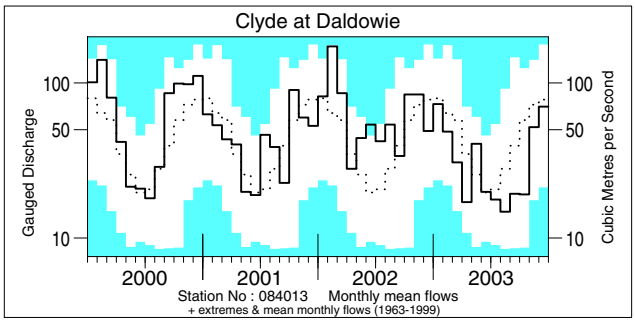
River flows - December 2003

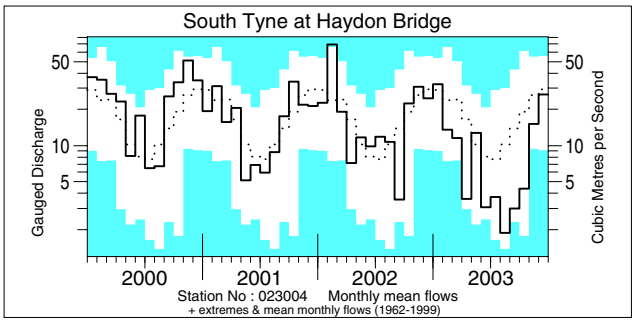
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

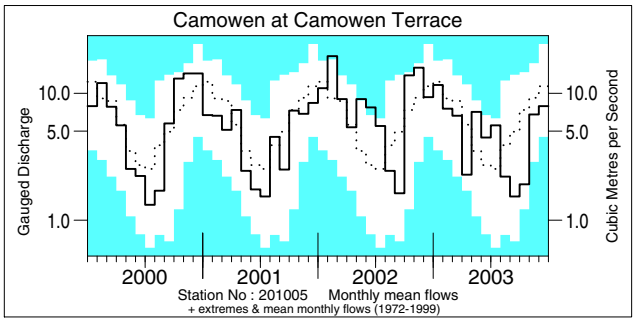
River flow . . . River flow . . .

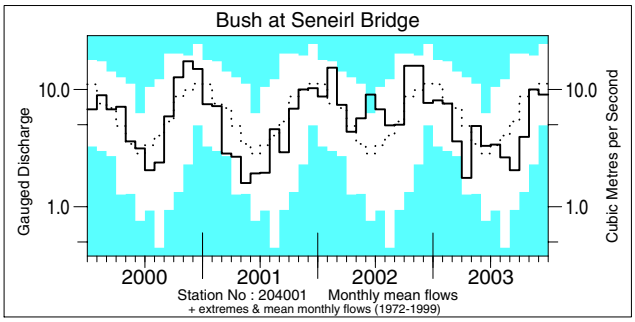


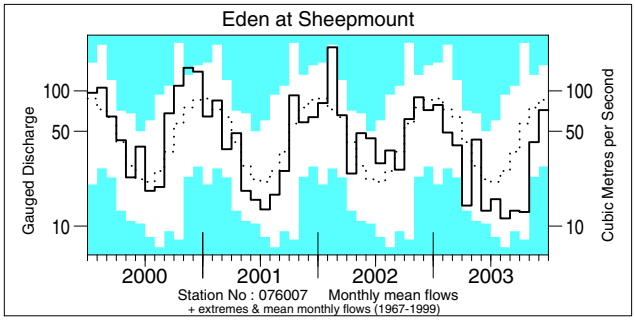


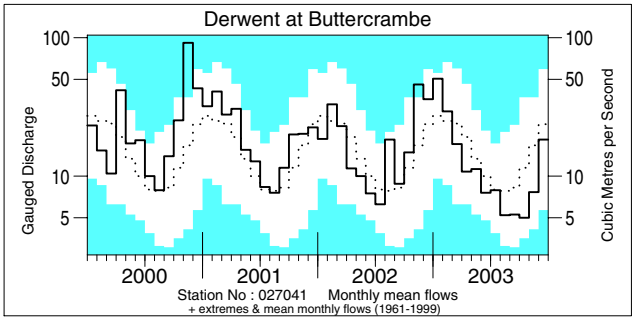


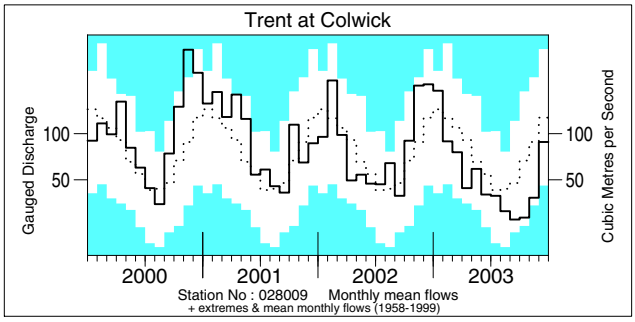


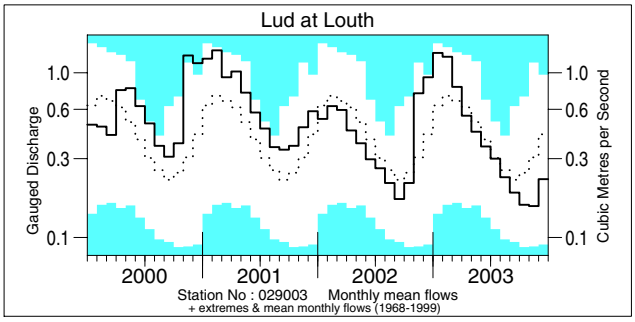








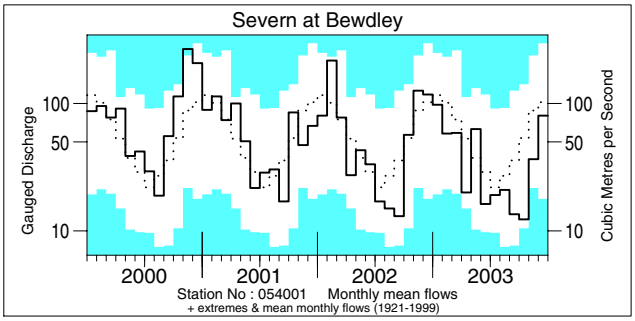


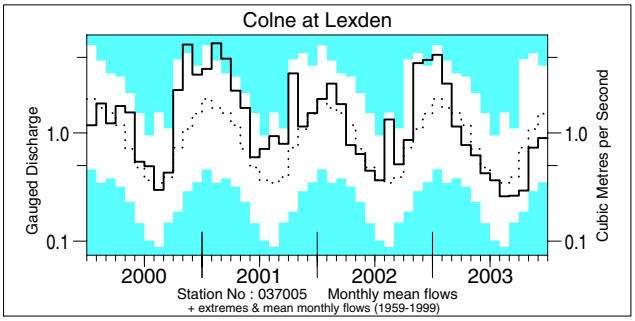


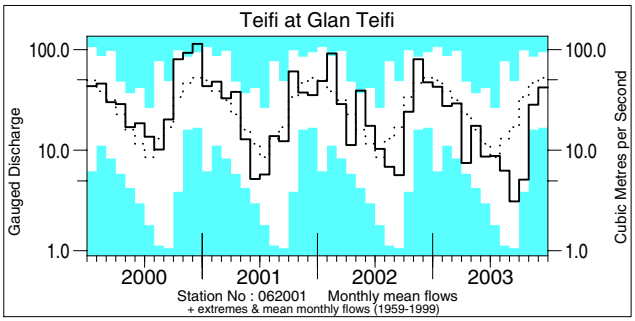
Monthly river flow hydrographs

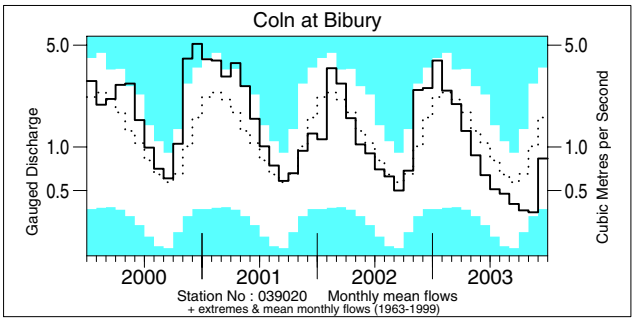
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

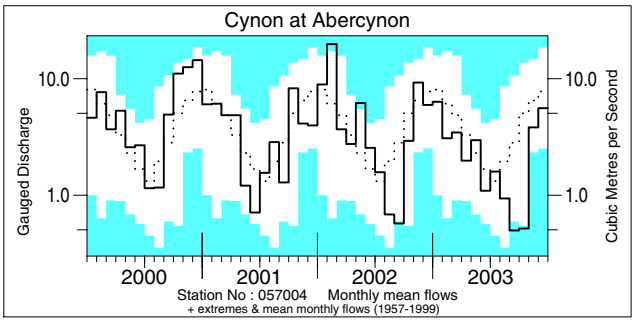
River flow . . . River flow . . .

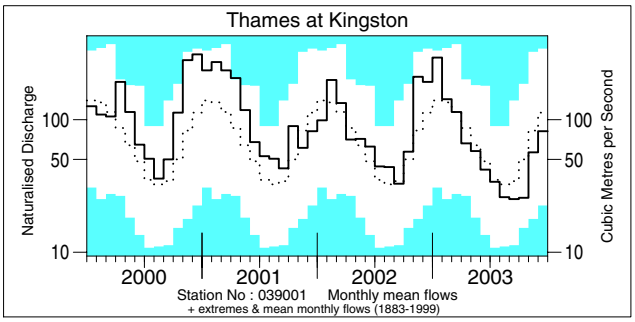


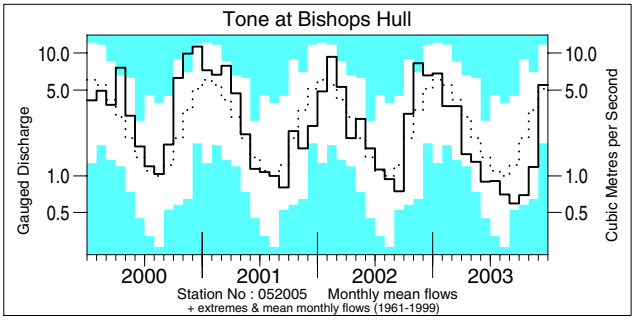


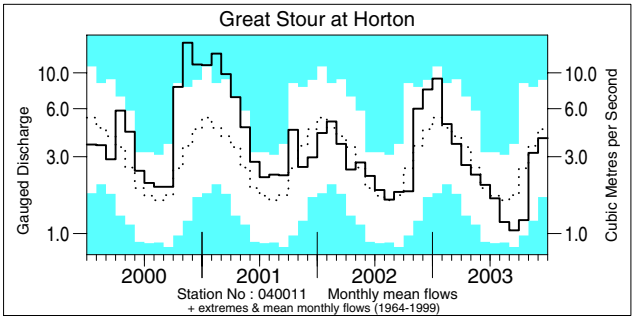


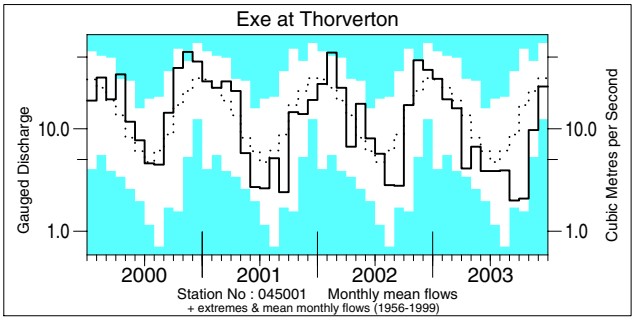


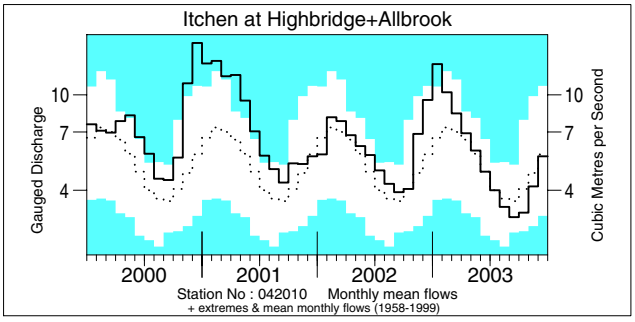












Notable runoff accumulations **(a) August 2003 - December 2003, (b) February 2003 - December 2003**

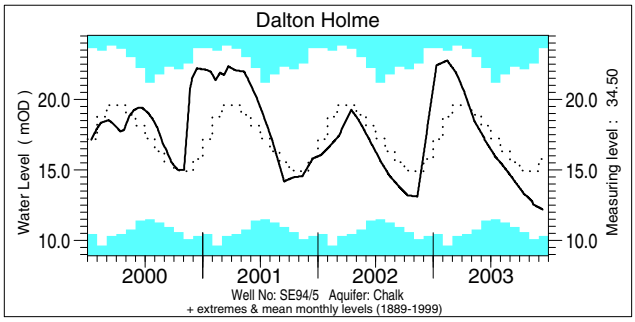
	River	%lta	Rank
a)	Dee (Park)	39	1/31
	Tay	56	1/51
	Earn	47	1/56
	Yscir	46	1/31
	Cynon	47	2/44
	Tawe	50	1/45
	Teifi	52	1/45
	Dee (New Inn)	62	2/35

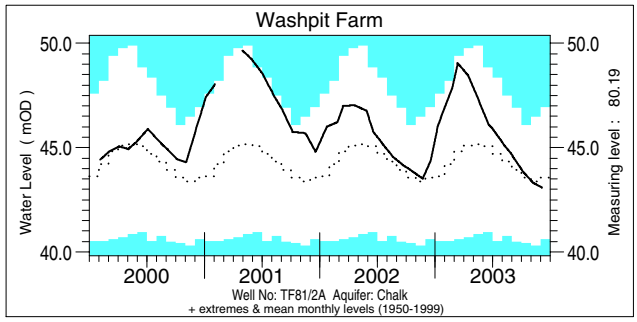
	River	%lta	Rank
b)	Spey (Boat o'Brig)	63	1/51
	Dee (Woodend)	59	1/74
	S. Tyne	52	1/40
	Soar	48	1/32
	Medway	51	2/40
	Stour (Dorset)	67	2/31
	Kenwyn	62	1/35
	Taw	49	1/45

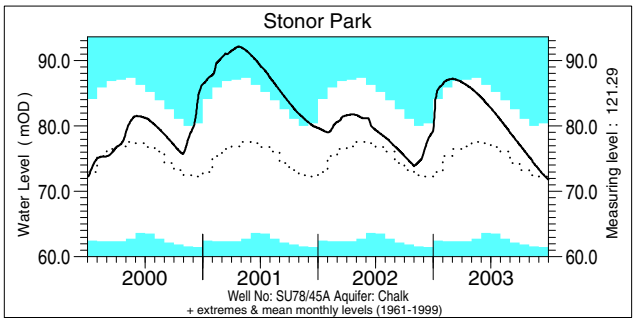
River	%lta	Rank
Teme	51	1/33
Eden	62	2/36
Luss	67	1/25
Carron	59	1/25
Ewe	71	2/33
Naver	66	1/26
Annacloy	59	1/24

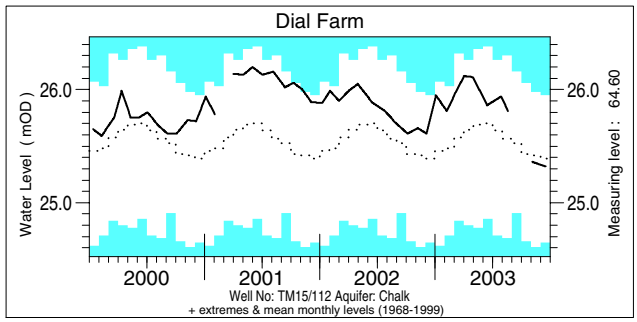
lta = long term average
Rank 1 = lowest on record

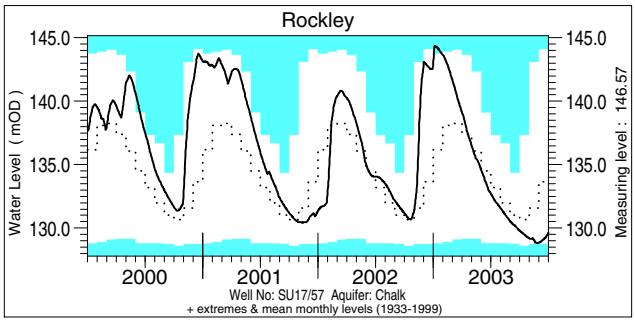
Groundwater . . . Groundwater

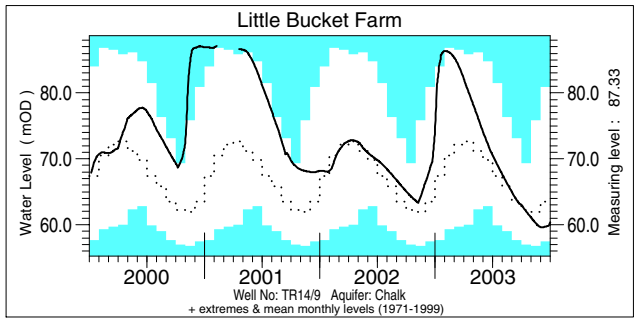


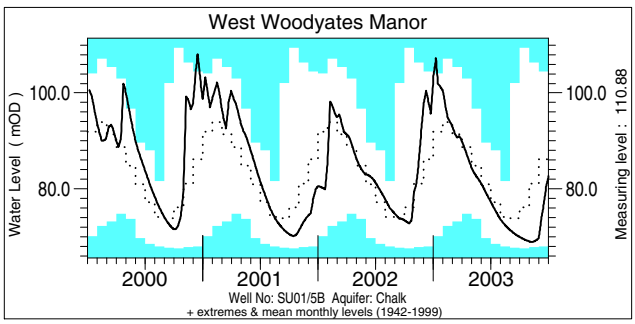


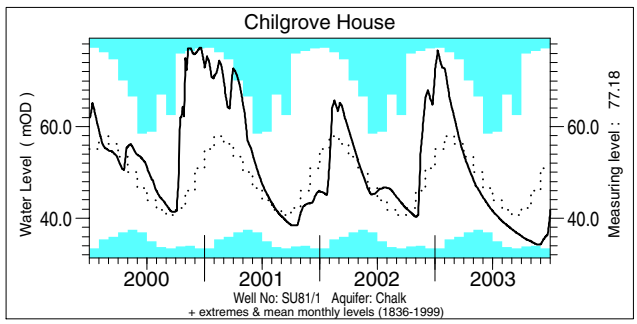


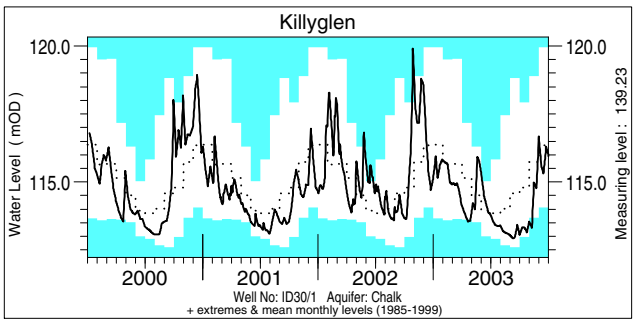


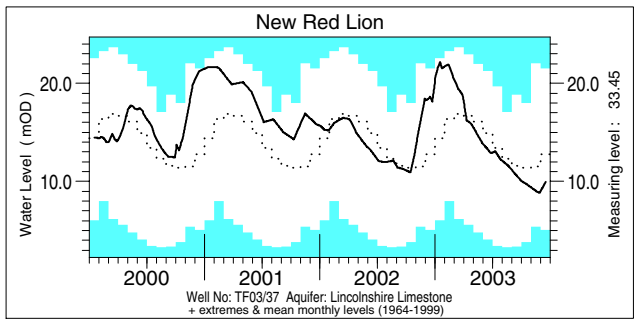






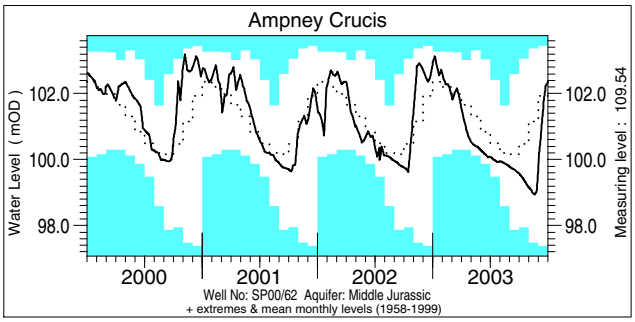


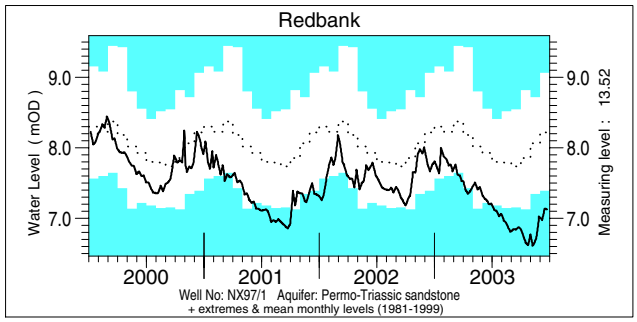


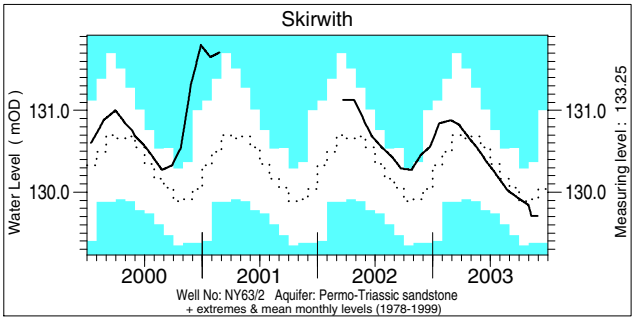


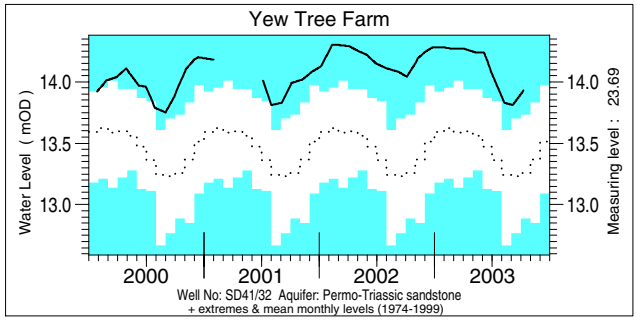
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

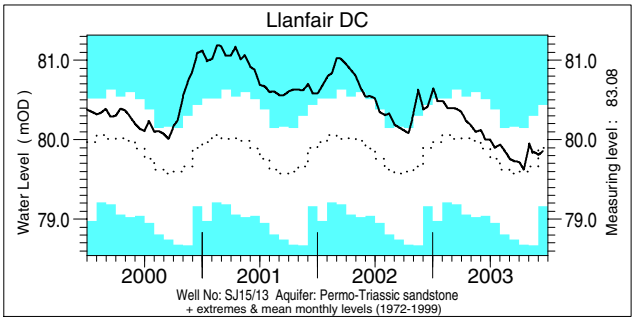
Groundwater . . . Groundwater

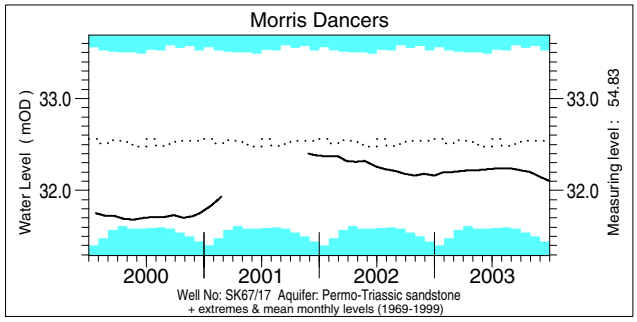


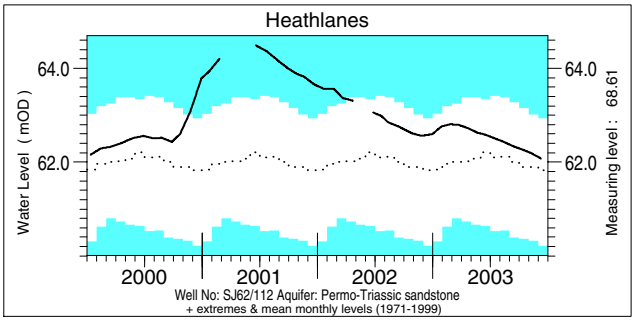


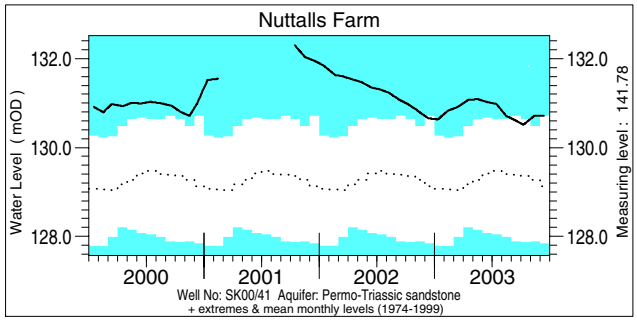


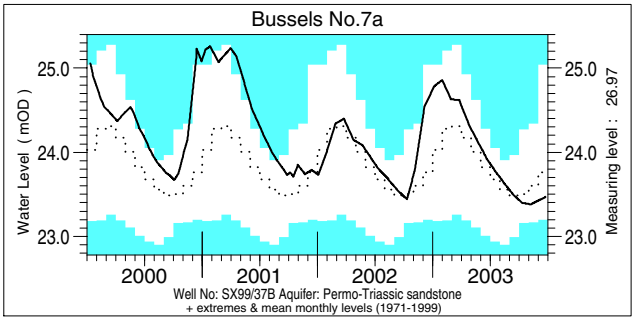


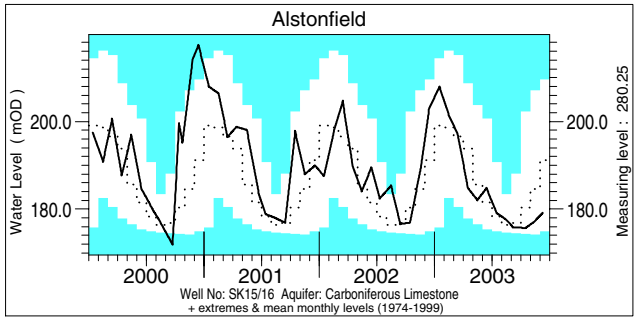












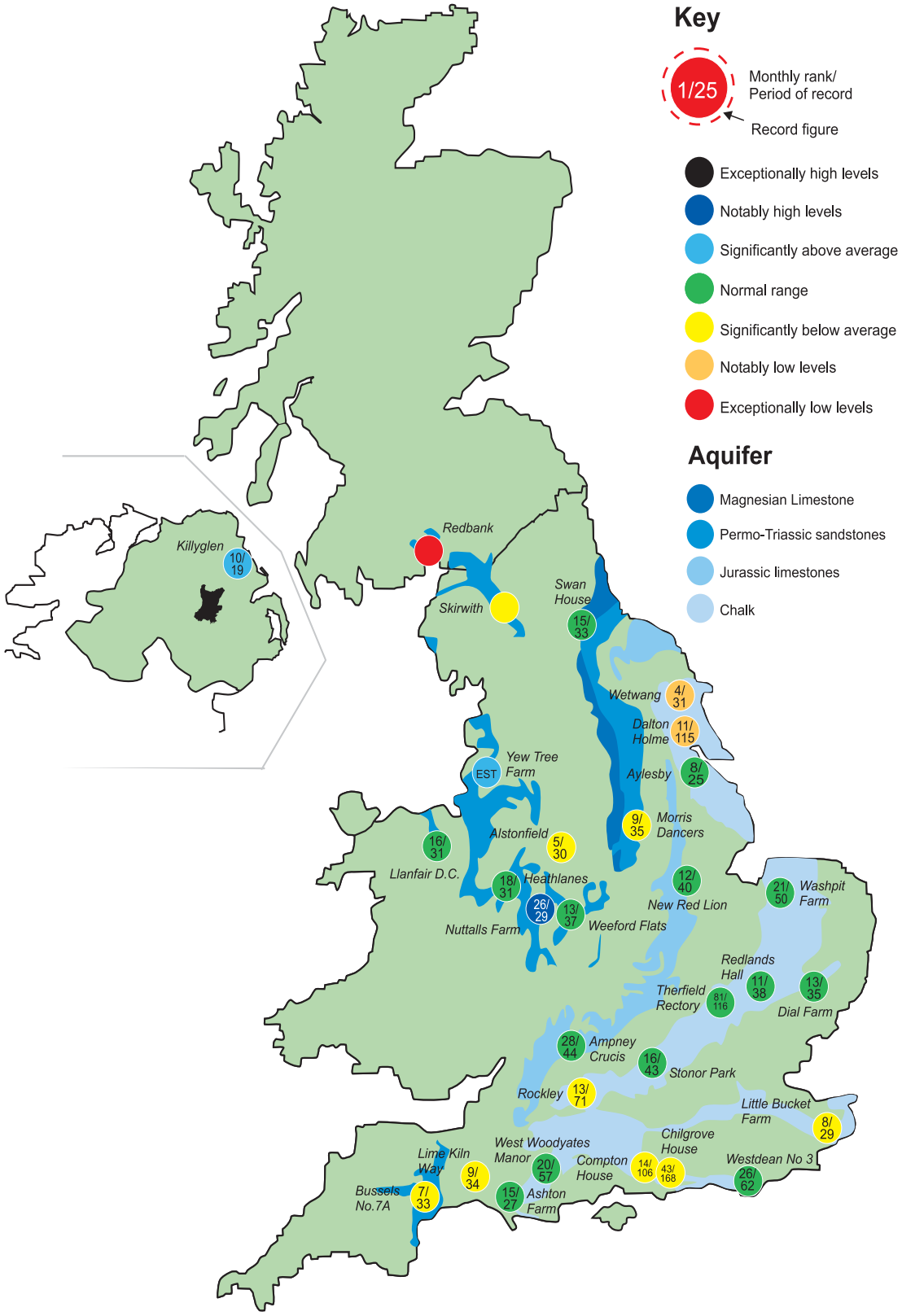
Groundwater levels December 2003 / January 2004

Borehole	Level	Date	Dec. av.
Dalton Holme	12.20	12/12	15.62
Washpit Farm	43.08	05/12	43.35
Stonor Park	71.77	31/12	72.87
Dial Farm	25.32	16/12	25.41
Rockley	129.66	31/12	133.86
Little Bucket Farm	61.31	05/01	64.98
West Woodyates	82.73	31/12	86.95

Borehole	Level	Date	Dec. av.
Chilgrove House	41.84	31/12	52.03
Killyglen	115.94	31/12	116.27
New Red Lion	9.97	16/12	12.94
Ampney Crucis	102.37	31/12	101.92
Redbank	7.13	22/12	8.14
Skirwith	129.71	28/11	130.24
Yew Tree Farm	13.93	08/10	13.63

Borehole	Level	Date	Dec. av.
Llanfair DC	79.86	15/12	79.87
Morris Dancers	32.10	30/12	32.40
Heathlanes	62.08	08/12	61.94
Nuttalls Farm	130.71	12/12	129.48
Bussels No.7a	23.47	23/12	23.85
Alstonfield	179.21	09/12	192.90

Levels in metres above Ordnance Datum



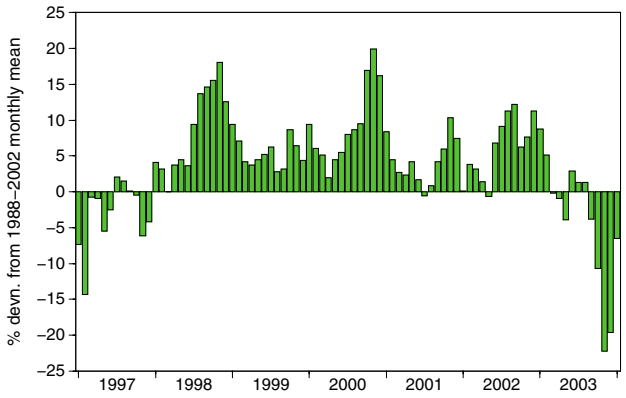
Groundwater levels - December 2003

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.

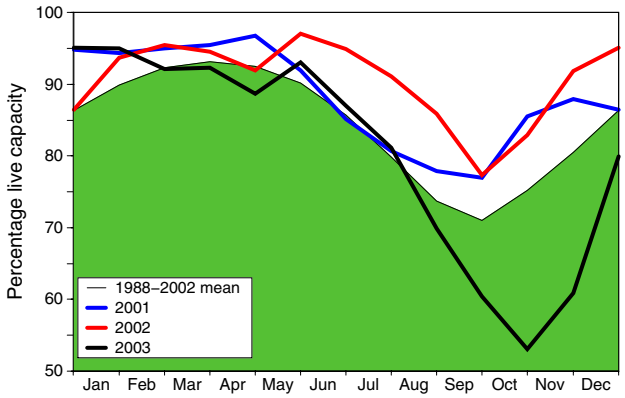
(Note: Redbank is affected by groundwater abstraction. Yew Tree Farm levels are now received quarterly, Skirwith data late.)

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.

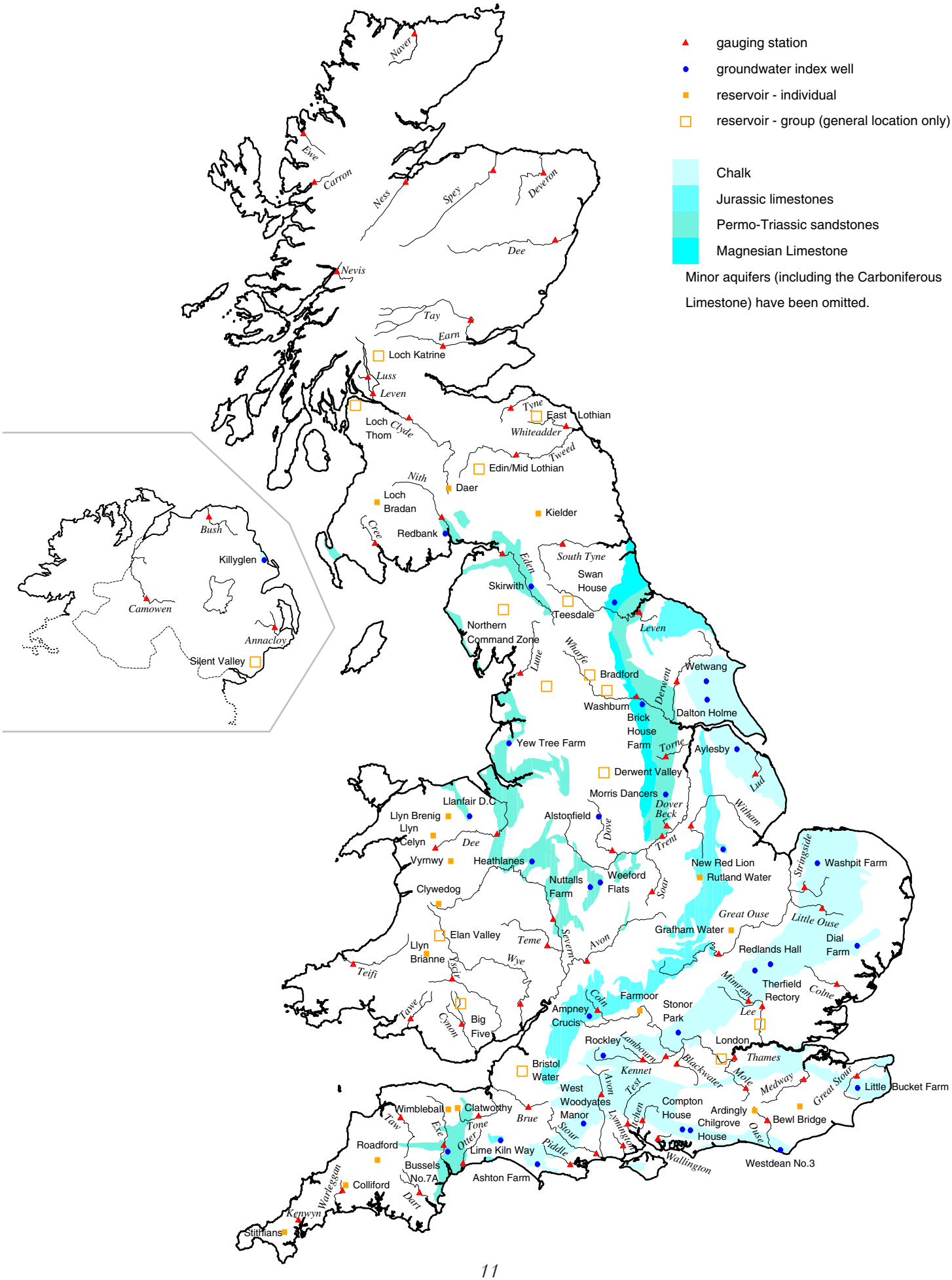
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2003 Aug	Sep	Oct	Nov	Dec	2004 Jan	Min. Jan	Year* of min.
North West	N Command Zone	• 124929	62	45	37	33	59	83	51	1996
	Vyrnwy	55146	82	70	59	60	64	86	35	1996
Northumbrian	Teesdale	• 87936	60	48	38	39	48	72	41	1996
	Kielder	(199175)	(86)	(81)	(76)	(66)	(64)	(78)	(70)	1990
Severn Trent	Clywedog	44922	95	82	69	61	73	90	54	1996
	Derwent Valley	• 39525	80	62	40	29	37	65	10	1996
Yorkshire	Washburn	• 22035	79	69	58	46	49	69	23	1996
	Bradford supply	• 41407	74	58	51	42	54	72	22	1996
Anglian	Grafham	(55490)	(89)	(79)	(72)	(64)	(67)	(74)	(57)	1998
	Rutland	(116580)	(87)	(79)	(73)	(66)	(65)	(71)	(60)	1991
Thames	London	• 202340	87	71	58	49	62	91	60	1991
	Farmoor	• 13830	89	71	54	43	59	97	71	1991
Southern	Bewl	28170	71	62	55	48	51	63	38	1991
	Ardingly	4685	77	53	32	15	23	41	41	2004
Wessex	Clatworthy	5364	55	43	25	14	16	54	54	2004
	Bristol WW	• (38666)	(79)	(79)	(79)	(48)	(44)	(64)	(40)	1991
South West	Colliford	28540	76	71	64	59	59	54	46	1996
	Roadford	34500	75	71	63	53	51	64	23	1996
	Wimbleball	21320	68	57	46	34	36	72	46	1996
	Stithians	5205	76	68	57	50	46	57	33	2002
Welsh	Celyn and Brenig	• 131155	93	84	77	75	81	91	54	1996
	Brianne	62140	95	85	76	71	81	96	76	1996
	Big Five	• 69762	79	64	48	38	53	76	67	1996
	Elan Valley	• 99106	76	62	48	41	56	88	56	1996
Scotland(E)	Edinburgh/Mid Lothian	• 97639	76	67	56	48	45	65	60	1999
	East Lothian	• 10206	75	67	61	38	38	78	48	1990
Scotland(W)	Loch Katrine	• 111363	77	66	54	40	66	80	80	2004
	Daer	22412	74	66	55	42	73	85	83	1996
	Loch Thom	• 11840	85	77	71	69	72	90	90	2004
Northern Ireland	Total+	•	84	77	64	54	59	62	61	2002
	Silent Valley	• 20634	86	78	62	47	47	54	39	2002

() 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 storage figures relate to the 1988-2004 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:

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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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