Hydrological summary

for Great Britain

March 1998

General

In recent years water resource prospects have often undergone substantial changes through the spring. This year, the late March and exceptional early April rainfall has been very beneficial from a water resources perspective - postponing the onset of reservoir depletion and extending the aquifer recharge season. After dipping in February, reservoir contents rose significantly in early March and again in April; overall stocks are now exceptionally healthy. March runoff totals were mostly in the normal range (flows increased steeply in April culminating in severe flooding over Easter). Residual evidence of the drought is now largely restricted to depressed groundwater levels in a zone centred on Hertfordshire, Cambridgeshire and Suffolk - the recent late pulse of infiltration should add momentum to the erstwhile very weak water-table recoveries in these areas.

Rainfall

The very notable dry interlude in February ended with the return of frontal systems on a westerly airstream at the beginning of March - a number of notable daily rainfall totals were reported e.g. 79 mm recorded at Nantmor (north Wales) and 100 mm at Princetown (Dartmoor) on the 2nd . However, from the 9th little or no rain fell during the following fortnight in some central localities. An unusual southerly airflow dominated synoptic patterns over the last week bringing remarkably mild conditions and significant rainfall to southern Britain especially. March rainfall totals exceeded the average in most regions, and some western districts were very wet - a monthly total of nearly 400 mm was recorded at Crai Reservoir in Wales - but parts of the English lowlands, mostly in East Anglia, fell short of the March average; some of these areas coincided with the districts with the most notable long term deficiencies. Scotland added a further notably high December - March rainfall total to the cluster over the last decade but, for the winter half-year (October-March) rainfall, although very episodic, was close to the 1961-90 average in all regions. This is true of accumulations over the last 12 months also. In the two-year timeframe some significant deficiencies persist, most notably in the east of the Thames region and parts of the Anglian region.

River Flow

The very extended recessions during February were reversed in early March and spates were recorded in many western catchments over the first 10 days, triggering minor flood alerts. Permeable catchments in the east were characteristically slower to respond and flows were very depressed around mid-month; since 1976 lower March flows on the Thames have been recorded only in 1992, 1993 and last year. Recoveries began thereafter and flows continued to increase in early April - heralding exceptional flooding over the 9-12th in the Midlands. March runoff totals for most index catchments were well within the normal range. Some, mostly western, rivers registered their highest March runoff for a decade whereas monthly totals of around 70-80% typified much of the English lowlands. Lower percentages characterised some eastern impermeable catchment (e.g. the Whiteadder) but the most depressed March runoff rates corresponded with the zone of maximum groundwater depletion. March flows in the River Lee were less than 50% of the monthly mean and the Mimram recorded its third lowest March runoff (after 1992 and 1973) in a series from 1952; flows have been below average since the autumn of 1995 and the accumulation is the lowest on record for the 12 months ending in March. However, the contraction in the headwater stream network was reversed in early April.

Groundwater

In most outcrop areas, the modest soil moisture deficits at the end of February were eliminated by early March but the dry interlude in mid-month meant that, initially, little further recharge occurred in the east. Fortunately, with very unsettled conditions continuing into April, significant infiltration recommenced - at a time when groundwater levels are normally in decline in the east. Throughout most northern, western and southern Chalk outcrops, March groundwater levels were well within the normal range, albeit mostly below average. In the zone of maximum depletion north of London, levels at the Holt and Redlands boreholes nudged above the monthly minima established in 1992 but the deep (and very slow responding) Therfield well remains dry. March levels in parts of Suffolk were very depressed also. However, even in the eastern Chalk the prospect of extremely low summer levels has decreased considerably over the last three weeks. In the limestone aquifers, and most minor aquifers (the Suffolk Crag excepted), groundwater levels remain in the normal range. There is much less spatial coherence in the Permo-Triassic outcrops but generally water-tables in March were well below average (although, commonly, still the highest for at least two years). Groundwater levels remain close to period-of-record minima in some, mostly confined aquifer units - where levels reflect infiltration over periods of years rather than months.

Institute of Hydrology

British Geological Survey

Rainfall accumulations and return period estimates

Area	Rainfall	Mar 1998	Jan 98-Mar 98	RP	Oct 97-Mar 98	RP	Apr 97-Mar 98	RP	Apr 96-Mar 98	RP
England & Wales	**mm**	**86**	**223**		**510**		**915**		**1647**	
	%	**119**	**100**	**<2**	**104**	**2-5**	**102**	**2-5**	**92**	**5-10**
North West	mm	144	337		668		1143		2206	
	%	152	115	2-5	100	<2	95	2-5	92	5-10
Northumbrian	mm	83	219		463		861		1605	
	%	118	103	2-5	101	2-5	101	2-5	94	2-5
Severn Trent	mm	80	197		416		813		1401	
	%	131	106	2-5	105	2-5	108	2-5	93	2-5
Yorkshire	mm	98	220		450		842		1528	
	%	144	107	2-5	102	2-5	103	2-5	93	2-5
Anglian	mm	52	125		313		629		1068	
	%	111	93	2-5	105	2-5	106	2-5	90	5-10
Thames	mm	60	150		366		671		1159	
	%	107	91	2-5	101	2-5	97	2-5	84	10-15
Southern	mm	63	179		518		826		1426	
	%	99	91	2-5	117	2-5	106	2-5	91	2-5
Wessex	mm	77	217		537		935		1647	
	%	110	98	2-5	113	2-5	112	2-5	98	2-5
South West	mm	111	304		759		1263		2272	
	%	112	90	2-5	106	2-5	108	2-5	97	2-5
Welsh	mm	168	397		830		1386		2513	
	%	157	115	2-5	107	2-5	106	2-5	96	2-5
Scotland	**mm**	**159**	**521**		**924**		**1486**		**2923**	
	%	**127**	**138**	**20-35**	**111**	**2-5**	**103**	**2-5**	**102**	**2-5**
Highland	mm	230	763		1173		1836		3616	
	%	142	160	120-170	109	2-5	104	2-5	103	2-5
North East	mm	86	236		556		1046		1938	
	%	110	98	2-5	105	2-5	108	2-5	100	2-5
Tay	mm	130	399		793		1263		2449	
	%	119	115	2-5	109	2-5	103	2-5	100	2-5
Forth	mm	105	358		674		1126		2239	
	%	112	123	5-10	107	2-5	102	2-5	101	2-5
Tweed	mm	87	251		550		996		1969	
	%	110	102	2-5	104	2-5	103	2-5	101	2-5
Solway	mm	177	448		925		1484		2872	
	%	151	120	2-5	112	2-5	104	2-5	101	2-5
Clyde	mm	147	579		1068		1645		3336	
	%	100	128	5-10	106	2-5	97	2-5	98	2-5

%= % of 1961-90 *RP = Return period*

 Recent monthly rainfall figures for the Scottish regions have ben compiled using data provided by the Scottish Environment Protection Agency. 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). The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts in the England & Wales and Scotland rainfall series can exaggerate the relative wetness of the recent past.

Rainfall . . . Rainfall . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

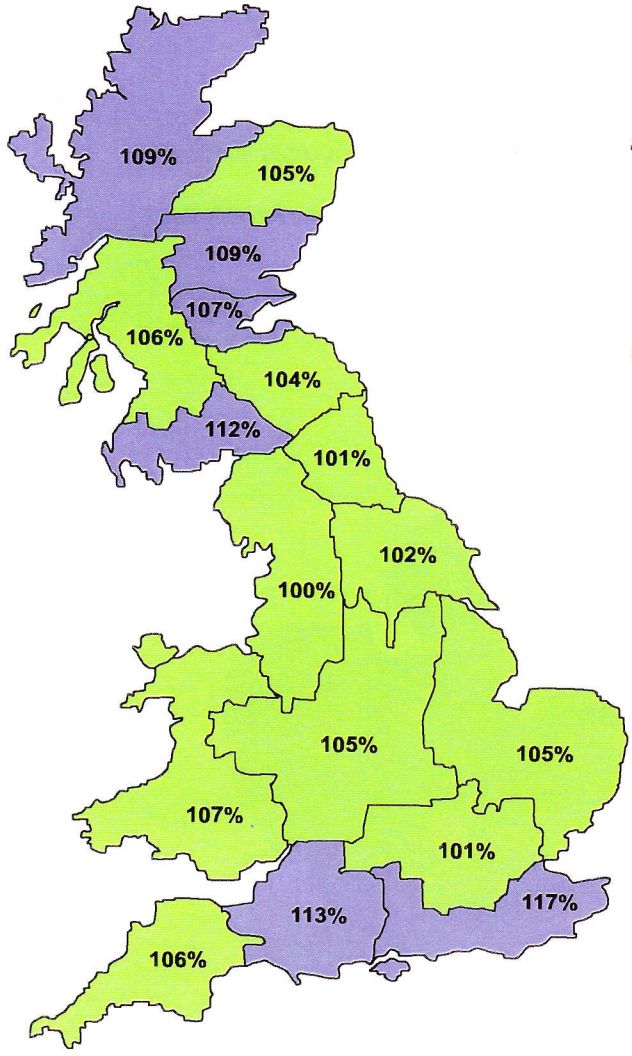
Above average

Normal range

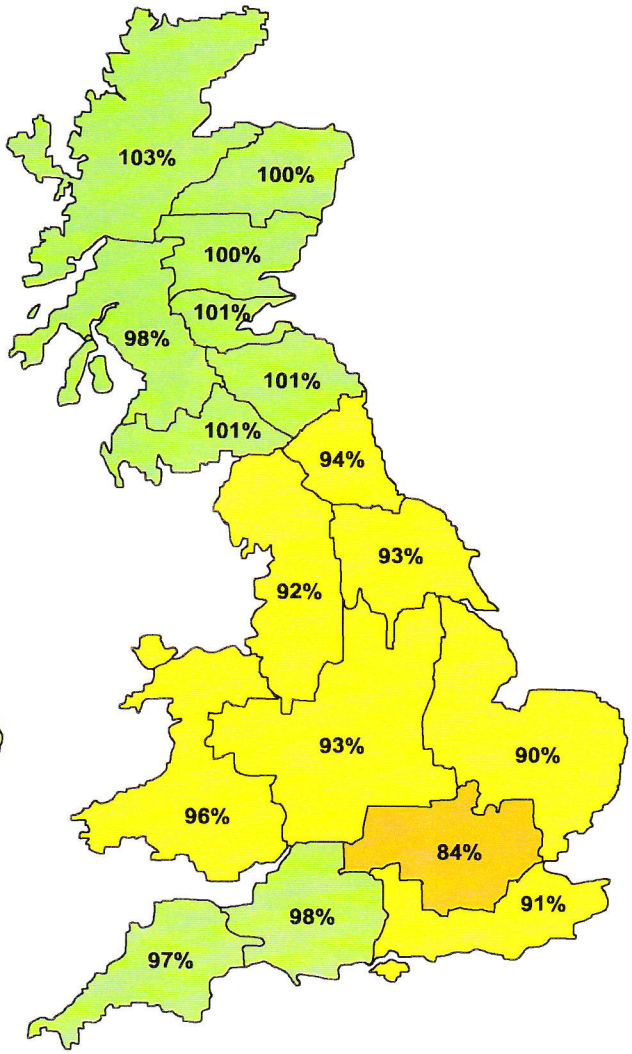
Below average

Substantially below average

Exceptionally low rainfall



October 1997 - March 1998



April 1996 - March 1998

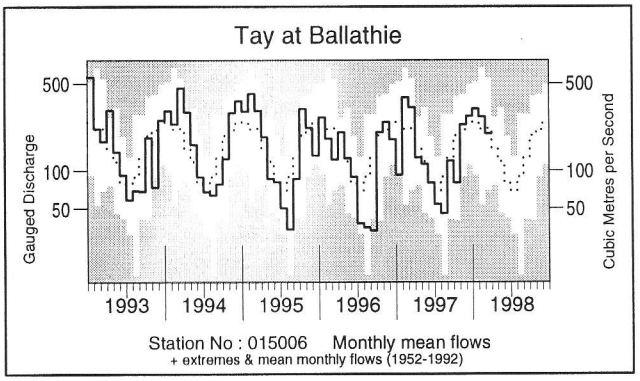
Rainfall accumulation maps

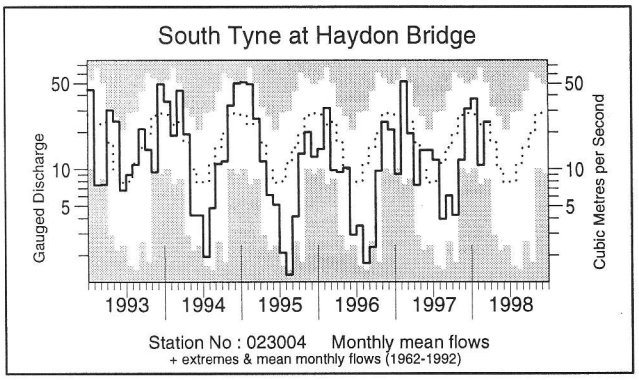
For England and Wales as a whole rainfall has been above average in seven of the last 11 months and the accumulated rainfall total since the summer of 1996 is very close to the 1961-90 average. Districts with longer term rainfall deficiencies of water resources significance are now very restricted in extent.

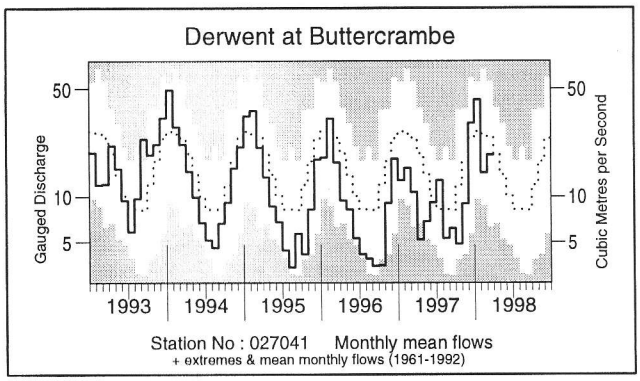
River flow . . . River flow . . .

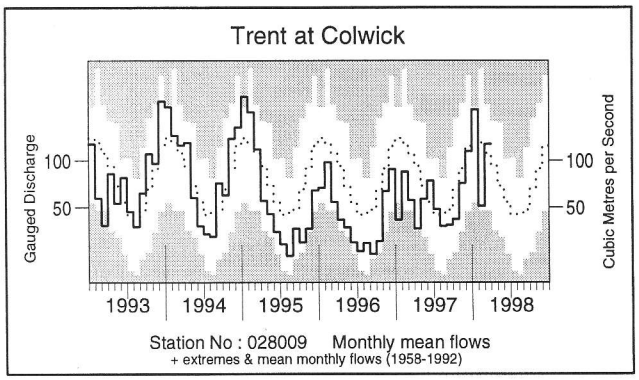
River flows - March 1998

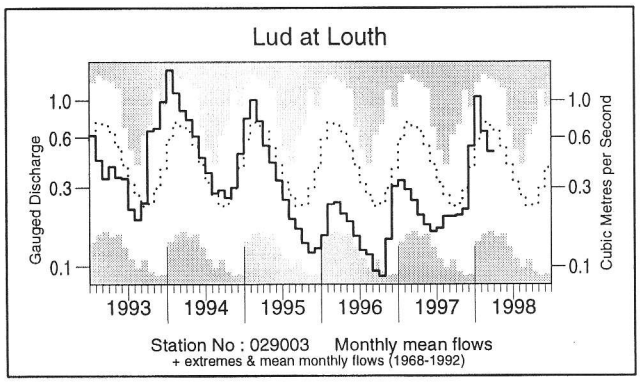
Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater.

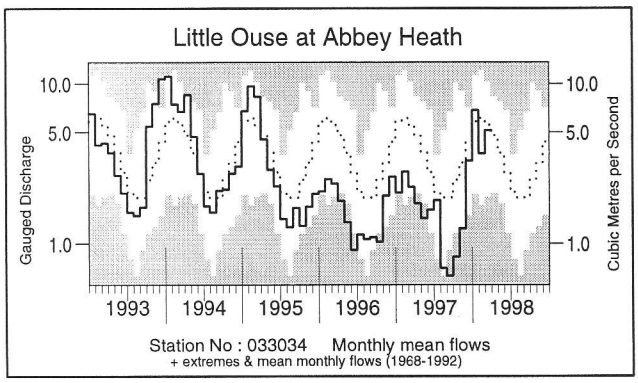


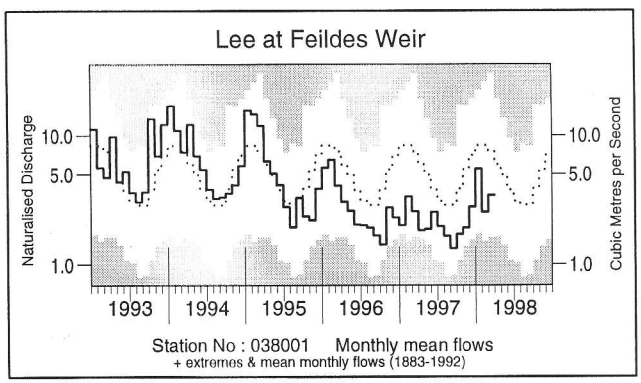


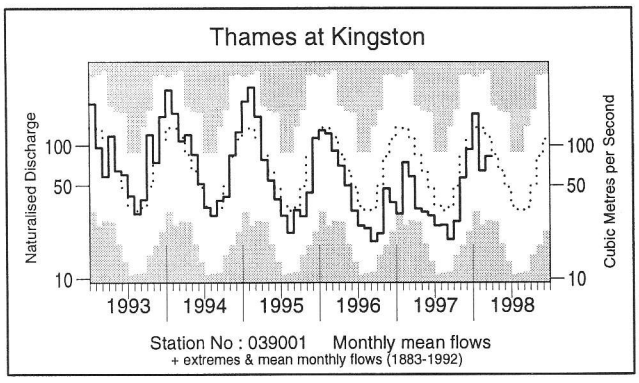








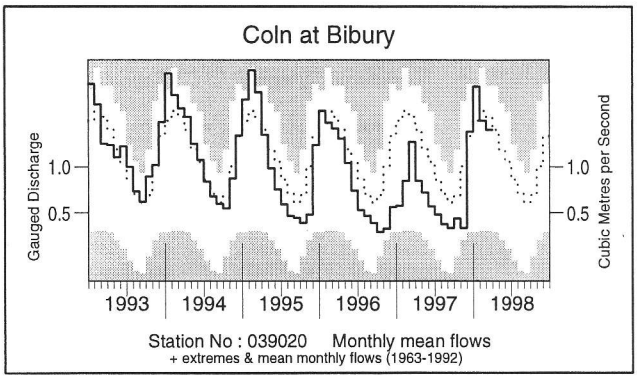


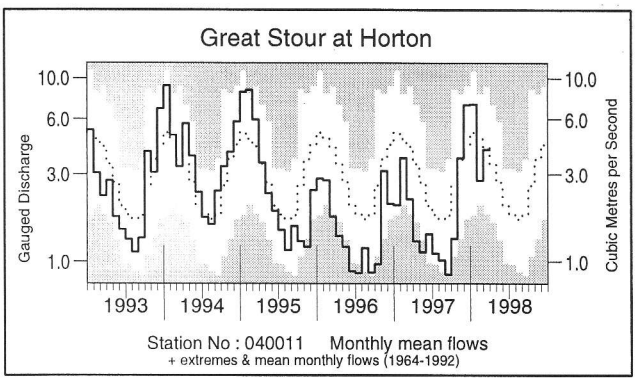


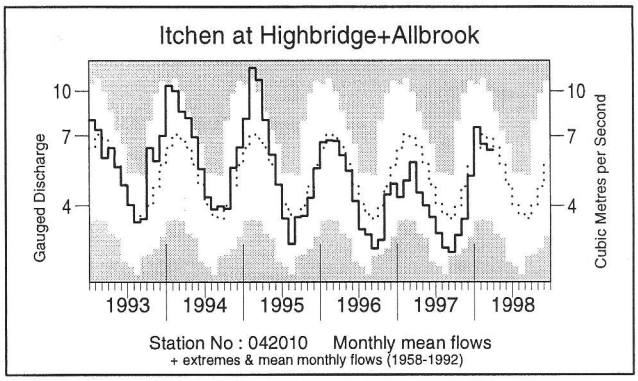
Monthly river flow hydrographs

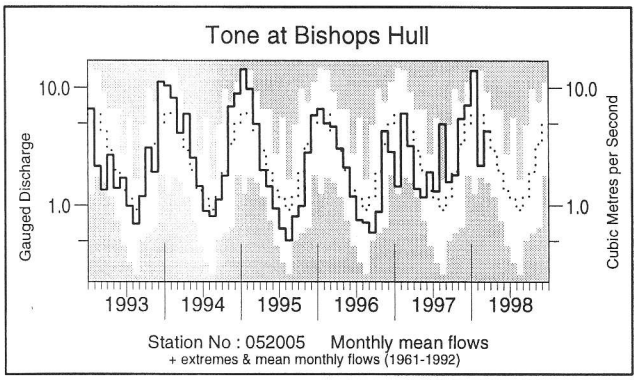
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1992 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

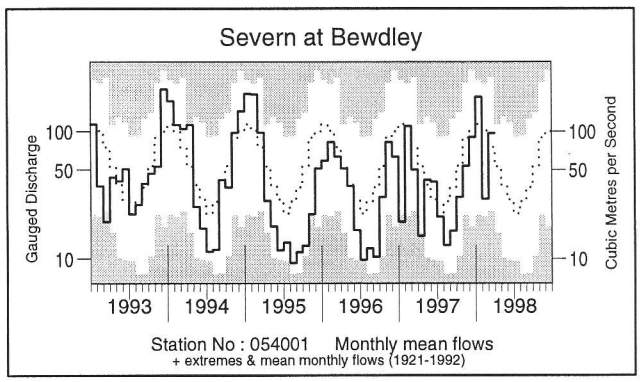
River flow . . . River flow . . .

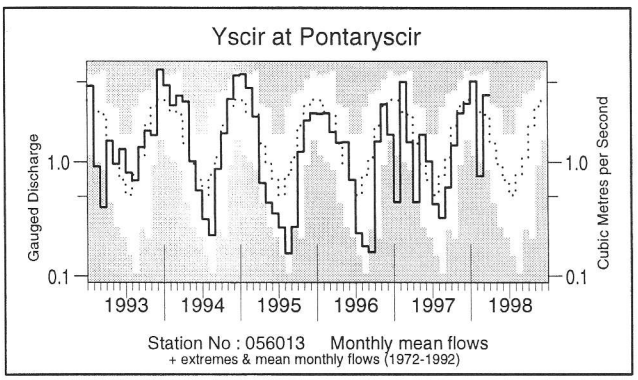


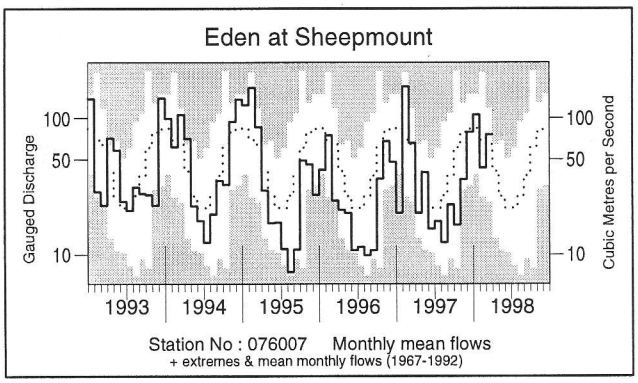


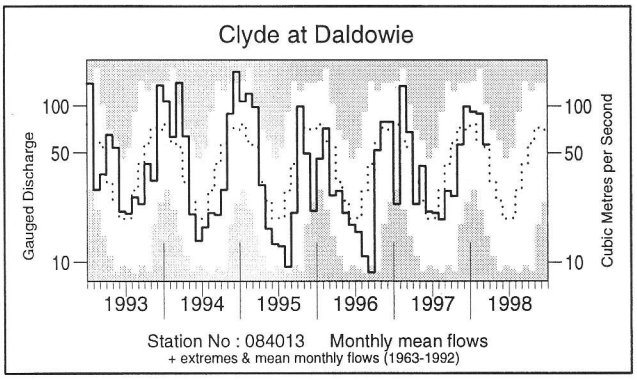










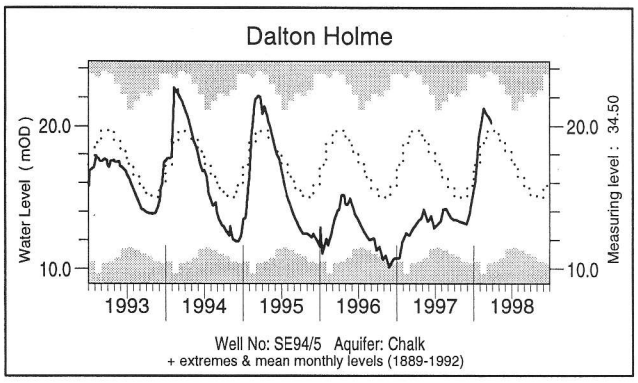


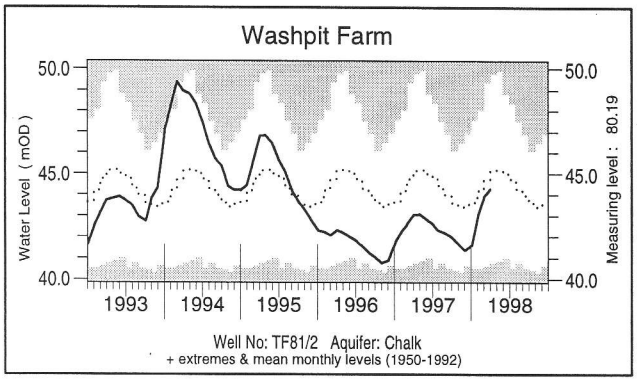
Notable runoff accumulations April 1997 - March 1998 (a); April 1996 - March 1998 (b)

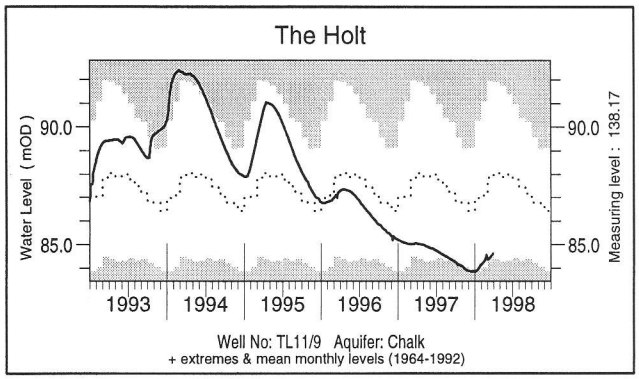
(a) River	%lta	Rank	(b) River	%lta	Rank	River	%lta	Rank
Carron	90	4/19	S.Tyne	77	3/32	Kennet	67	2/35
Mimram	45	1/45	Wharfe	82	5/41	Ouse	62	2/30
Kennet	72	5/36	Dove	73	2/35	Avon	65	2/32
Mole	**117**	**20/23**	Soar	58	2/25	Brue	72	3/32
Test	74	4/39	Mimram	51	1/44	Lune	85	4/34
Tone	**130**	**33/37**				Carron	90	5/18

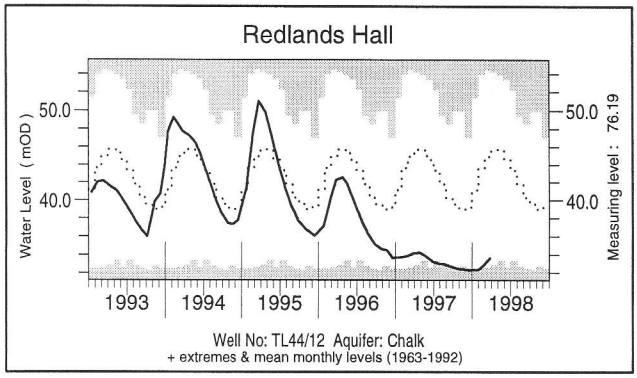
lta = long term average
Rank 1 = lowest on record

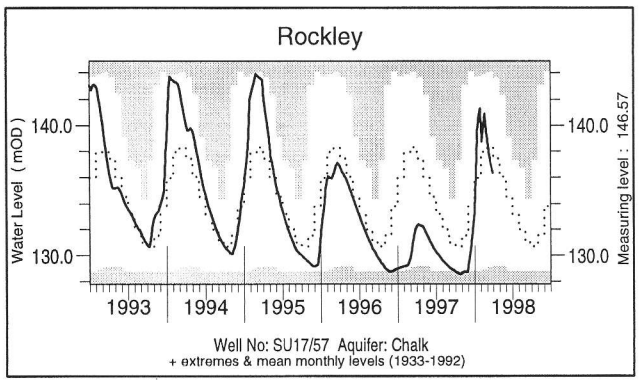
Groundwater . . . Groundwater

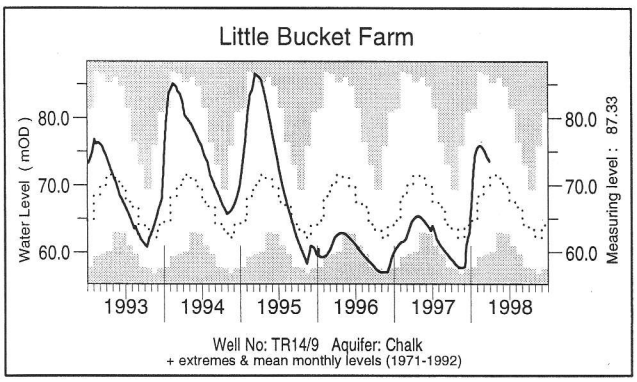


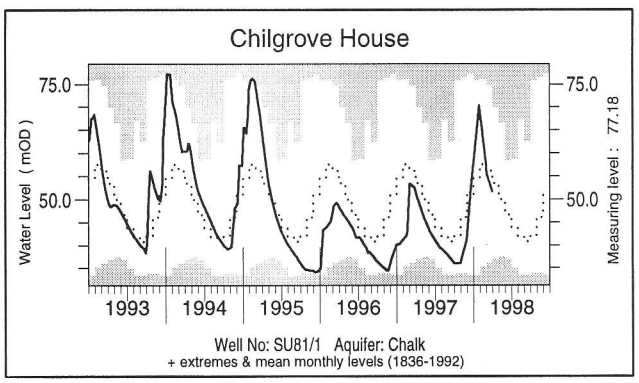


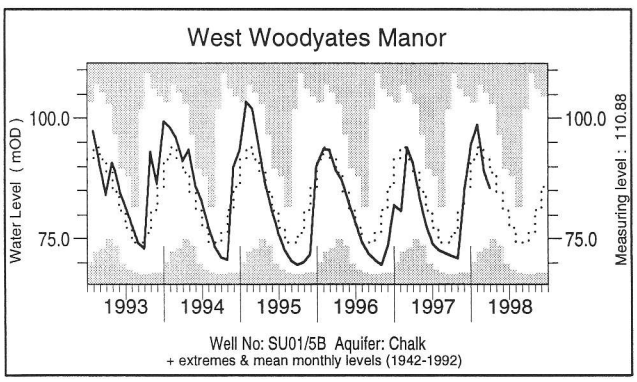








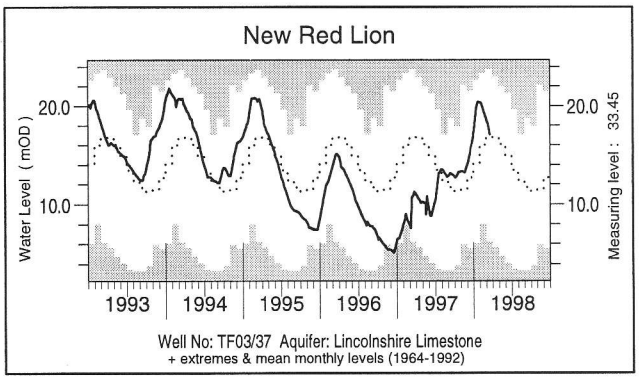


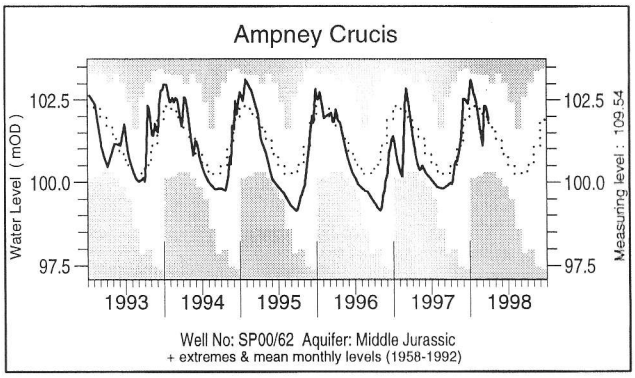


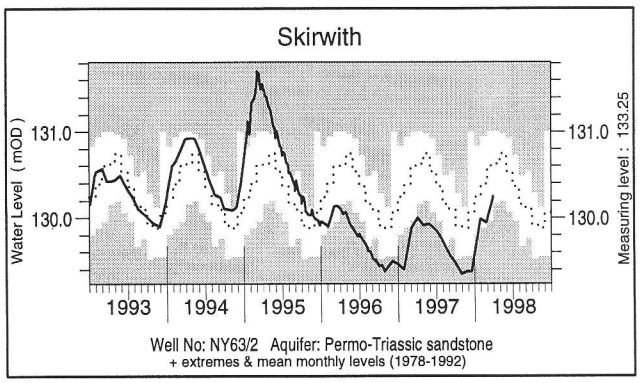
What is groundwater?

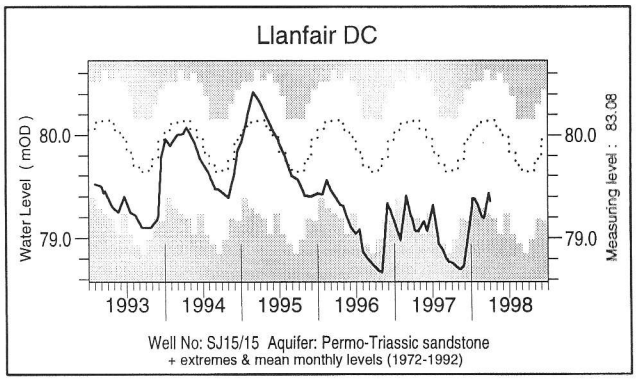
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment 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.

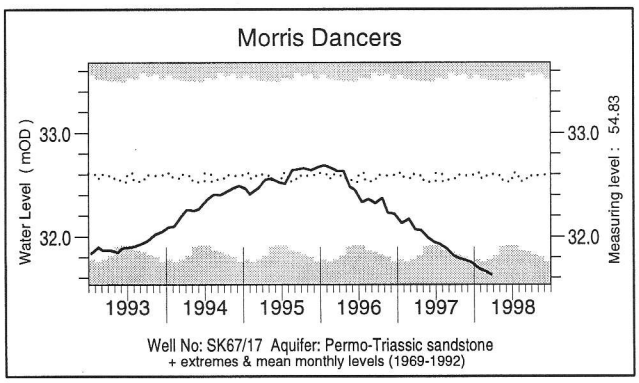
Groundwater . . . Groundwater

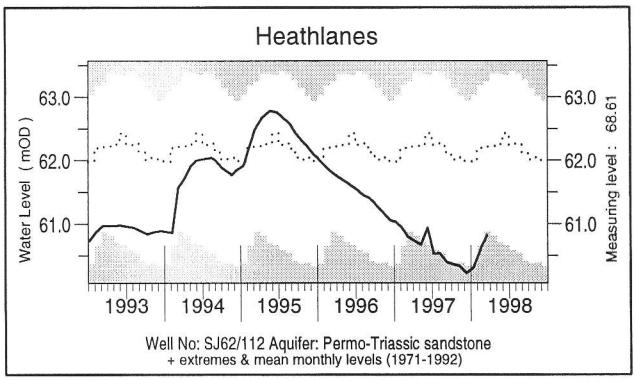


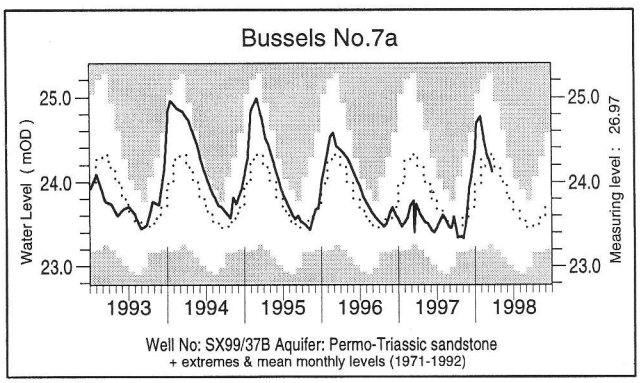


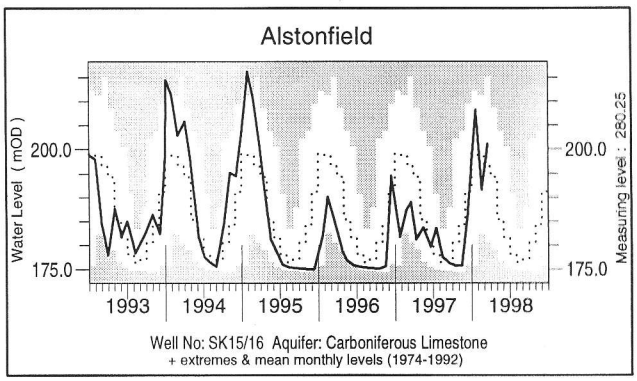












Groundwater levels March/April 1998

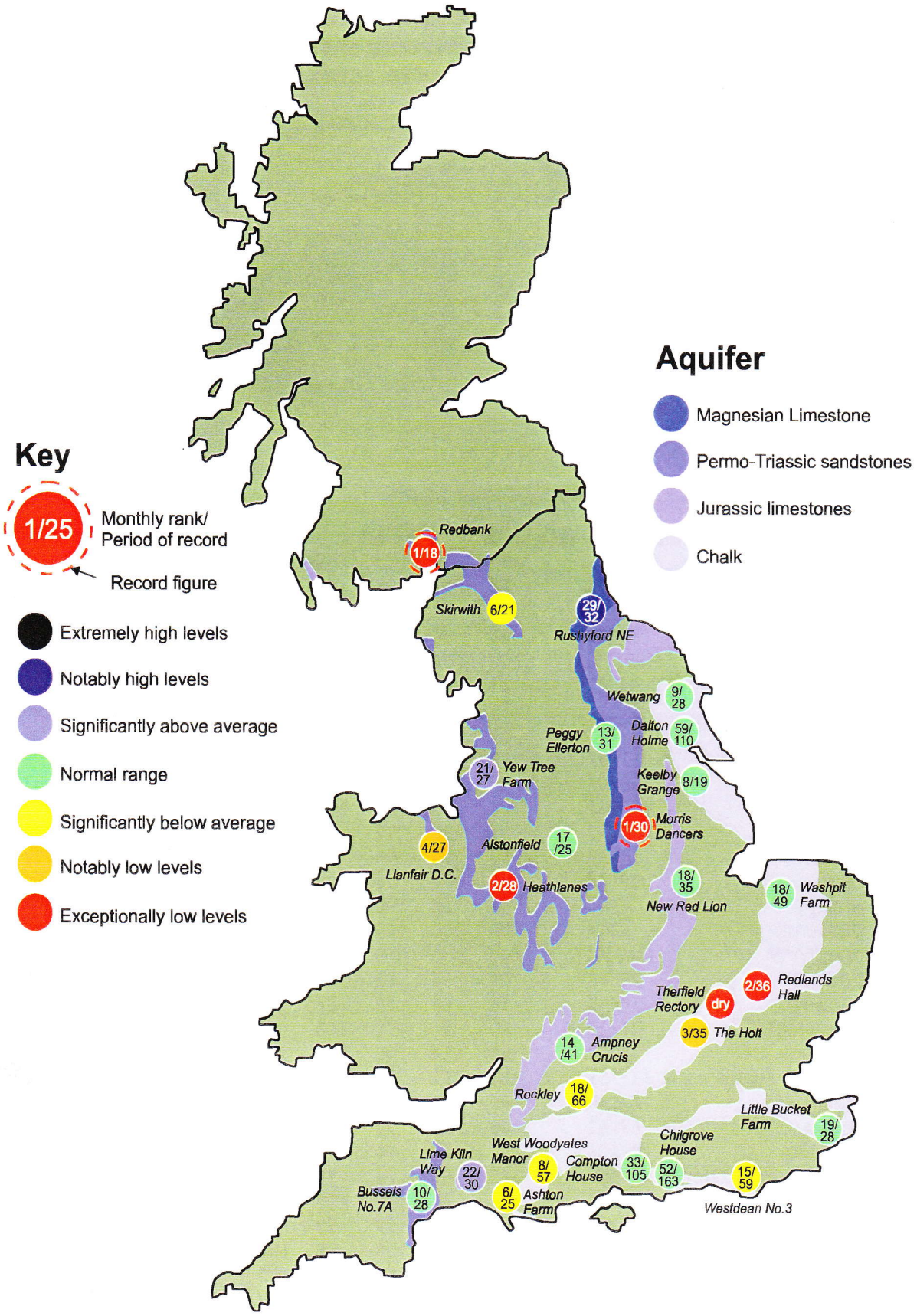
Borehole	Level	Date	Mar av.
Dalton Holme	20.20	27/03	19.49
Washpit Farm	44.28	01/04	44.83
The Holt	84.63	25/03	87.77
Redlands Hall	33.60	25/03	44.04
Ashton Farm	68.74	31/03	69.58
Little Bucket	73.60	30/03	71.52

Borehole	Level	Date	Mar av.
Chilgrove	51.68	31/03	55.47
W Woodyates	85.63	31/03	90.70
New Red Lion	17.06	17/03	16.50
Ampney Crucis	101.9	30/03	102.03
Skirwith	130.3	30/03	130.64

Borehole	Level	Date	Mar av.
Llanfair DC	79.36	01/04	79.97
Morris Dancers	31.63	23/03	32.49
Heathlanes	60.83	18/03	62.03
Bussels	24.12	24/03	24.30
Alstonfield	201.1	17/03	195.44

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

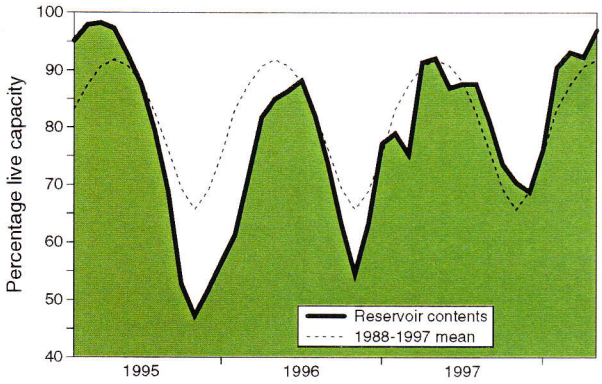


Groundwater levels - March 1998

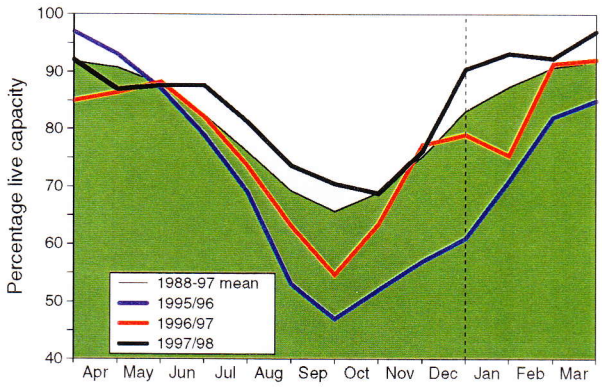
The rankings are based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. Caution needs to be exercised when interpreting the ranking, especially during periods of rapid changes in groundwater level. Rankings may be omitted where they are considered misleading.

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

Area	Reservoir	Capacity (Ml)	1997 Nov	Dec	1998 Jan	Feb	Mar	Apr	Min. Apr	Year* of min
NorthWest	N Command Zone	• 133375	53	64	95	94	92	94	77	1993
	Vyrnwy	55146	59	67	100	93	87	100	64	1996
Northumbrian	Teesdale	• 87936	65	73	96	97	93	99	77	1996
	Kielder	(199175)	(82)	(75)	(95)	(91)	(91)	(96)	(81)	1993
SevernTrent	Clywedog	44922	81	86	86	89	86	96	86	1996
	DerwentValley	• 39525	73	79	100	100	90	98	54	1996
Yorkshire	Washburn	• 22035	60	73	98	98	95	99	70	1996
	Bradford supply	• 41407	72	85	99	98	96	100	59	1996
Anglian	Grafham	58707	44	47	57	67	75	86	77	1997
	Rutland	130061	71	75	88	96	96	98	74	1992
Thames	London	• 206399	51	68	72	93	97	99	88	1990
	Farmoor	• 13843	97	92	96	94	97	100	84	1992
Southern	Bewl	28170	56	76	98	100	99	100	58	1989
	Ardingly	4685	68	100	100	100	100	100	100	**1998**
Wessex	Clatworthy	5364	85	100	100	92	86	100	82	1992
	BristolWW	• (38666)	(62)	(71)	(97)	(97)	(94)	(98)	(71)	1992
SouthWest	Colliford	28540	44	53	62	68	68	73	58	1997
	Roadford	34500	56	65	78	84	84	91	37	1996
	Wimbleball	21320	80	91	100	100	97	100	78	1996
	Stithians	5205	68	84	100	100	96	100	52	1992
Welsh	Celyn and Brenig	• 131155	82	86	99	97	98	100	72	1996
	Brianne	62140	97	100	100	94	94	97	90	1993
	Big Five	• 69762	69	87	98	96	91	98	78	1993
	Elan Valley	• 99106	92	100	100	97	93	99	89	1993
East of	Edinburgh/Mid Lothian	• 97639	62	67	74	80	79	71	71	**1998**
Scotland	East Lothian	• 10206	62	63	100	100	99	100	95	1990
West of	Loch Katrine	• 111363	76	86	97	88	95	97	94	1996
Scotland	Daer	22412	70	87	100	98	100	100	96	1996
	LochThom	• 11840	74	82	93	93	100	100	98	1996

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

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 area; this can be particularly important during droughts.
The minimum storage figures relate to the 1988-1997 period only. In some gravity-fed reservoirs (eg. Clywedog) stocks are kept below capacity during the winter to provide scope for flood alleviation.

Location map . . . Location map

Where the information comes from

The National Hydrological Monitoring Programme was instigated in 1988 and is undertaken jointly by 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 of the Environment, Transport and the Regions, the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA) and the Office of Water Services (OFWAT).

River flow and groundwater levels

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

River flow and groundwater level data are provided by the regional divisions of the EA (England and Wales) and SEPA (Scotland). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

Reservoirs

Reservoir level information is provided by the Water Service Companies, the EA and, in Scotland, the West of Scotland and East of Scotland Water Authorities.

Rainfall

Most rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data are presented for the regional divisions of the precursor organisations of the EA and SEPA. The recent rainfall estimates for the Scottish regions are derived by IH in collaboration with the SEPA regions. In England and Wales the recent rainfall figures derive from MORECS. MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain. The provisional regional rainfall figures are regularly updated using figures derived from a much denser rainguage network. Further details of Met. Office services can be obtained from:

The Meteorological Office
Sutton House
London Road
Bracknell
RG12 2SY.
Tel. 01344 856858; 01344 854024.

The cooperation of all data suppliers is gratefully acknowledged.

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