Hydrological summary

for Great Britain

November 1998

General

November was a cold, sunny month with near average rainfall in most regions. Levels in some major reservoirs were drawn down to provide flood attenuation storage but overall stocks for England and Wales remain around 93% of capacity - the highest for early December since the national monitoring programme began (note however, that stocks in the spring of 1999 will be more important in relation to the water resources outlook for next summer). River flows were substantially above average in most regions during November but - the first couple of days aside - flooding was limited and localised. A few pockets of depressed groundwater levels remain but brisk recoveries characterised most aquifer outcrop areas.

Rainfall

The very unsettled weather patterns of late September and October continued into November with a succession of westerly frontal systems crossing much of the country. Subsequently, anticyclonic conditions became more common, producing a protracted dry spell in mid-month in large parts of the English lowlands; the dry and cold weather contrasted with more maritime conditions to the west and north. Milder westerly airflows reasserted themselves over the final week. Regional rainfall totals for November were relatively close to the average throughout Britain - most being in the 80-135% range with the wettest areas in southern Scotland where some districts approached twice the average. By contrast, the eastern Thames Valley reported less than 60% and parts of the lower Trent valley fell below 40% - both areas where the residual long term rainfall deficiencies are most significant. Notwithstanding the relatively dry conclusion to autumn, England and Wales registered its wettest Sept-Nov period since 1984. More notably, rainfall for the year thus far exceeds the annual average in all regions, notably so in north-east Britain. For England and Wales, provisional data suggest that the Jan-Nov period is the wettest since 1960. In the same timeframe, the provisional total for Scotland ranks third highest in a series from 1869 (1990 and 1992 were wetter). Long term deficiencies have been greatly reduced over the last eight months and are of hydrological significance only in a few areas (see below).

River Flows

The month began with widespread spate conditions and flooding in a number of responsive catchments (e.g. in the Tweed basin). Recessions had became well established in many impermeable western catchments by mid-month but increased baseflows, following the heavy early autumn rainfall, maintained high runoff rates in many permeable lowland catchments. Flows were close to bankfull on the Thames early in November and the monthly runoff was the highest in the last 24 years - around twice the monthly average despite the catchment rainfall only being about 80% of the 1961-90 mean. Generally, monthly runoff totals were well above average and approached November maxima for many gauging stations (e.g. on the Whiteadder, Kennet, Coln and Hampshire Avon). Autumn runoff totals were also exceptional - unprecedented for the Whiteadder, Yscir and the Dove - and catchments recording new maximum Jan-Nov runoff totals showed a very wide distribution. By contrast, flows in the Mimram were below average for the 37th successive month and the accumulated runoff deficiency is unprecedented in the three-year timeframe. Combinations of below average flows and large long term runoff deficiencies are, however, mostly confined to a small minority of spring-fed lowland rivers.

Groundwater

The very wet early autumn produced near saturated soil conditions in most aquifer outcrop areas and infiltration in the five weeks to mid-November was heavy. In some aquifers - particularly where the water-table was depressed in the summer - recoveries have been delayed, but generally groundwater levels were rising briskly through November. Most November levels in the Chalk were close to the average in the eastern outcrops (although levels in the upper Lee catchment remain depressed), and well above average to the west where Rockley reported its second highest November level in 38 years. Rapid recoveries have produced very healthy levels in most limestone aquifers also - but levels declined somewhat in the more responsive units towards month end. The recent heavy infiltration is also reflected in the notably high late-autumn levels in many Permo-Triassic sandstones outcrops (e.g. at Bussels and Skirwith) by contrast its benefit is still awaited in a number of very slow responding aquifer units - particularly at the borehole Morris Dancers where the November level was the lowest on record. Overall, groundwater resources have improved substantially over the last three months and average rainfall through until next April will produce a healthy outlook in almost all areas.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall. .

Rainfall accumulations and return period estimates

Area	Rainfall	Nov 1998	Sep98-Nov 98	RP	Jun 98-Nov 98	RP	Jan 98-Nov 98	RP	Dec 96-Nov 98	RP
England & Wales	**mm**	**82**	**322**		**552**		**950**		**1868**	
	%	**91**	**128**	**5-10**	**121**	**5-10**	**118**	**10-15**	**104**	**2-5**
North West	mm	121	430		768		1265		2442	
	%	99	117	2-5	120	5-10	117	5-10	101	2-5
Northumbria	mm	100	296		590		1031		1953	
	%	116	126	5-10	134	15-25	134	50-80	114	10-20
Severn Trent	mm	62	285		490		825		1617	
	%	87	143	10-20	130	10-20	122	10-20	107	2-5
Yorkshire	mm	77	277		500		888		1757	
	%	96	125	5-10	121	5-10	120	10-15	107	2-5
Anglian	mm	54	220		387		649		1269	
	%	93	139	10-15	124	5-10	120	5-15	106	2-5
Thames	mm	66	293		451		752		1401	
	%	101	158	20-35	130	10-15	122	5-15	102	2-5
Southern	mm	64	318		474		793		1610	
	%	75	136	5-10	121	5-10	114	5-10	103	2-5
Wessex	mm	69	325		528		915		1826	
	%	83	139	5-10	129	5-15	123	10-15	109	2-5
South West	mm	127	447		722		1246		2495	
	%	101	134	5-10	130	10-20	120	5-15	106	2-5
Welsh	mm	126	506		840		1437		2763	
	%	89	128	5-10	129	10-20	124	10-20	105	2-5
Scotland	**mm**	**174**	**505**		**882**		**1546**		**3066**	
	%	**115**	**113**	**2-5**	**118**	**5-10**	**120**	**20-35**	**107**	**5-10**
Highland	mm	191	543		946		1829		3637	
	%	94	95	2-5	105	2-5	117	10-20	103	2-5
North East	mm	114	353		649		1079		2202	
	%	115	125	5-10	128	10-20	123	20-35	113	10-20
Tay	mm	163	493		816		1359		2697	
	%	135	135	5-15	134	20-35	123	10-20	110	5-10
Forth	mm	157	494		841		1361		2558	
	%	140	147	25-40	146	120-170	136	>200	115	20-30
Tweed	mm	126	356		629		1073		2203	
	%	135	129	5-10	125	5-15	122	10-20	114	10-20
Solway	mm	190	570		1016		1586		3095	
	%	132	128	5-10	138	35-50	125	20-35	109	5-10
Clyde	mm	212	587		1051		1767		3455	
	%	118	106	2-5	118	5-10	116	5-15	102	2-5

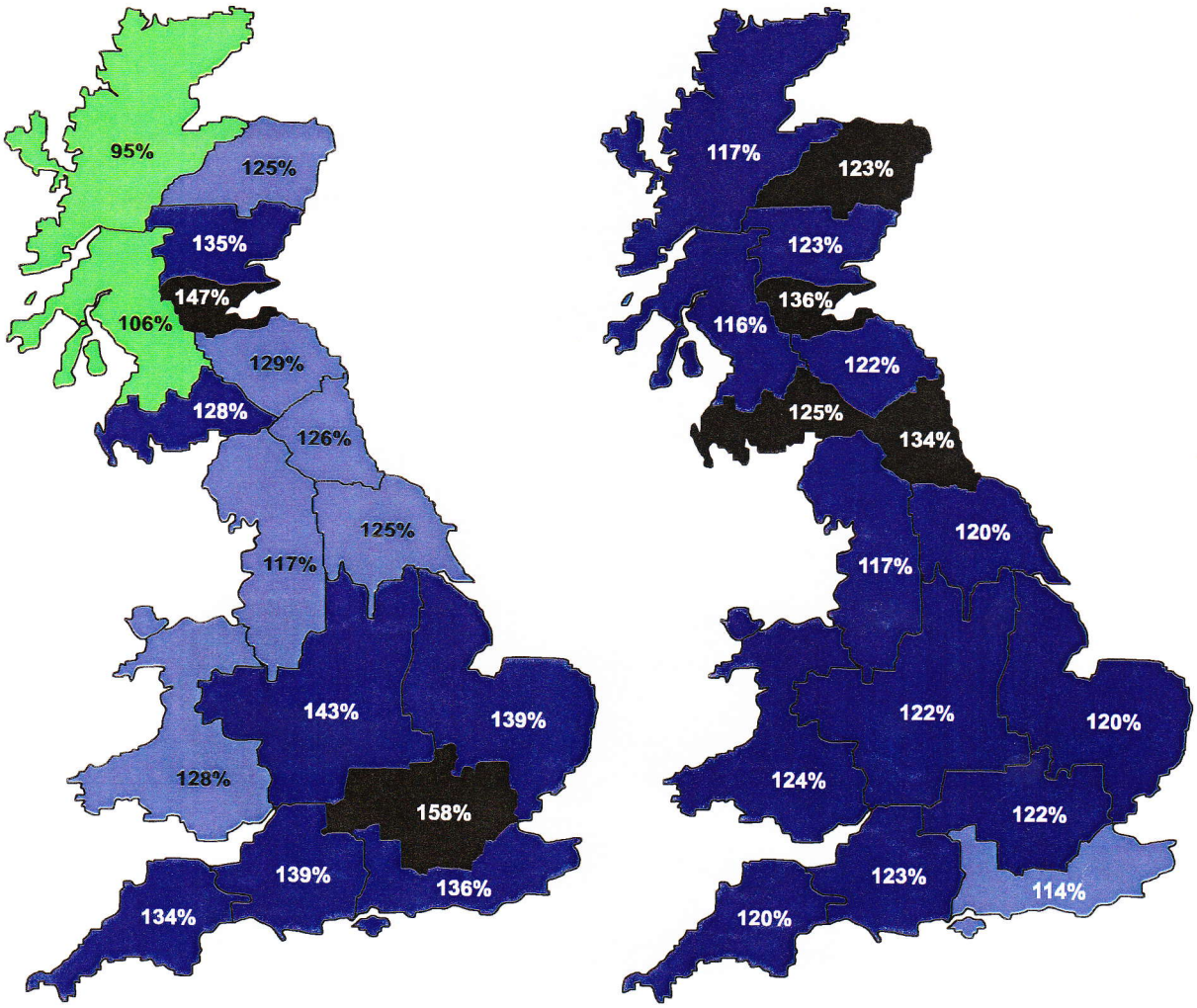
RP = Return period

 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. *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

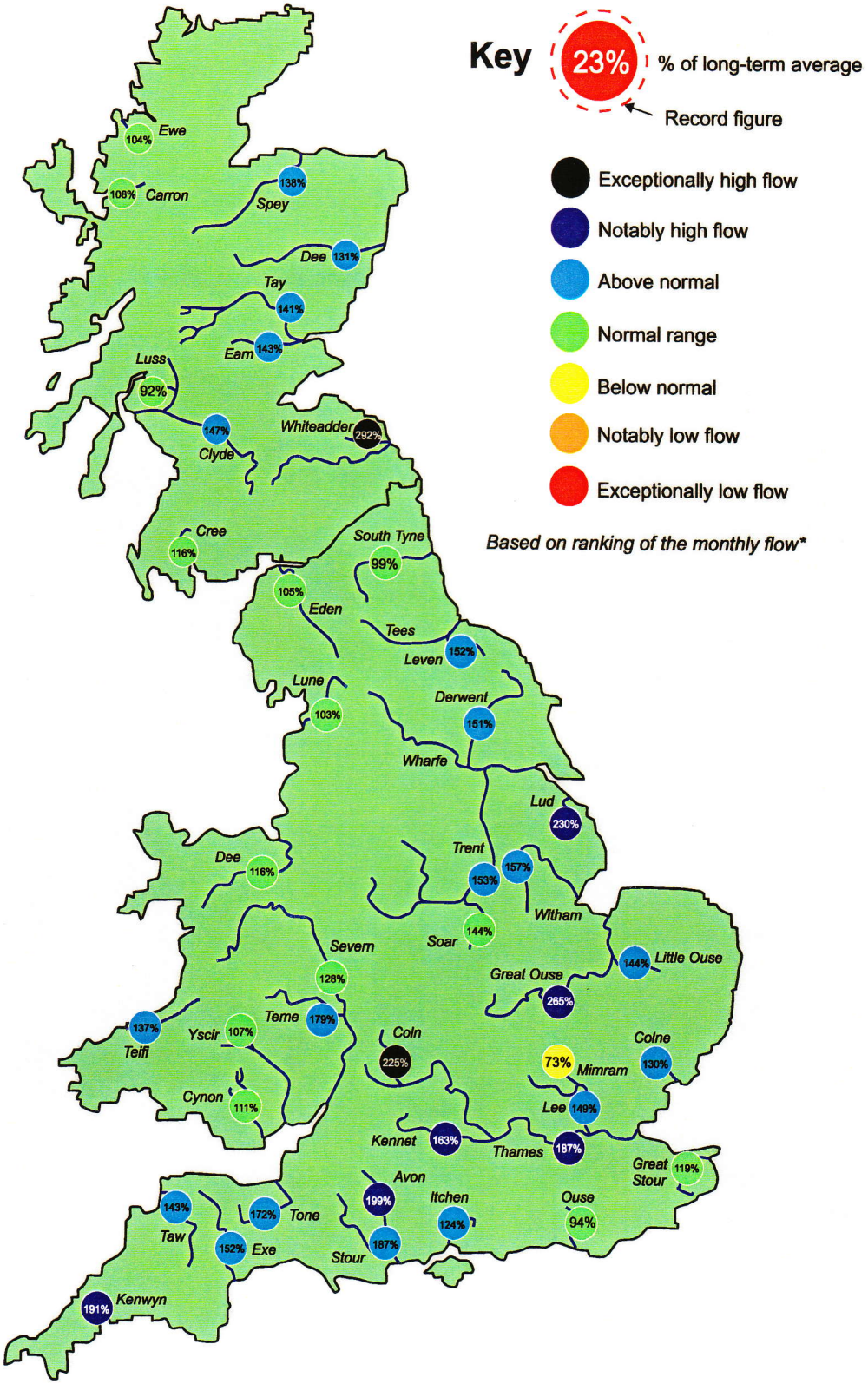


September 1998 - November 1998 **January 1998 - November 1998**

Rainfall accumulation maps

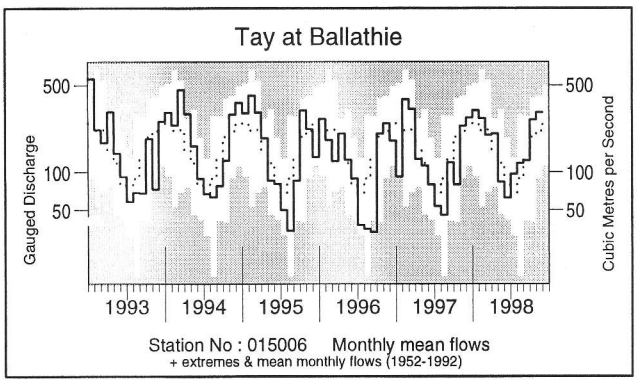
In contrast to 1997, when the autumn was the second driest in 20 years, the September-November period this year has been the wettest since 1984 for Britain as a whole. A wet phase extends back to the early spring; provisional data suggest that the March-November period for Britain has been the third wettest since 1927 (1992 was wetter).

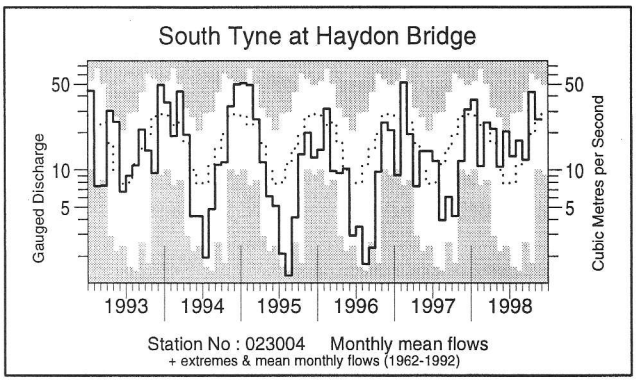
River flow . . . River flow . . .

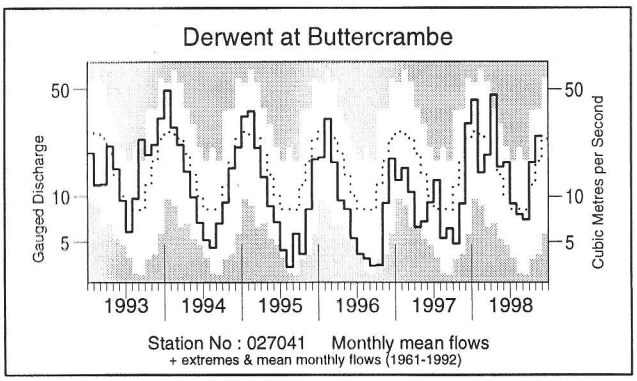


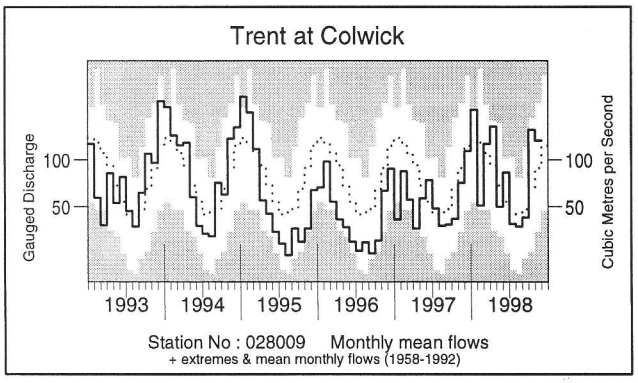
River flows - November 1998

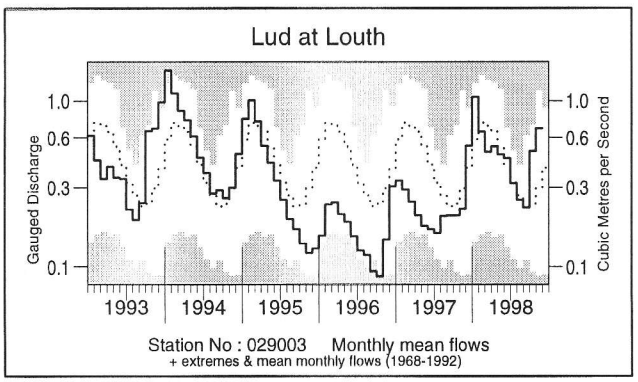
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

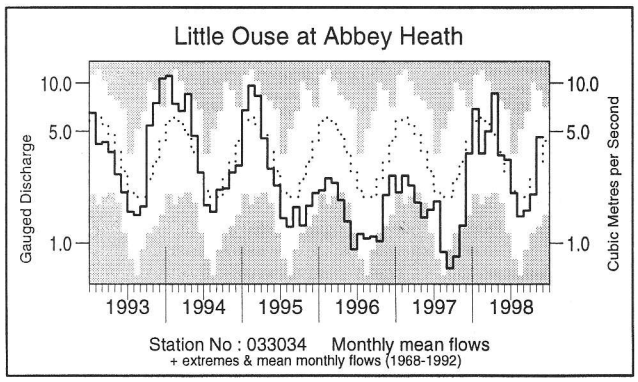


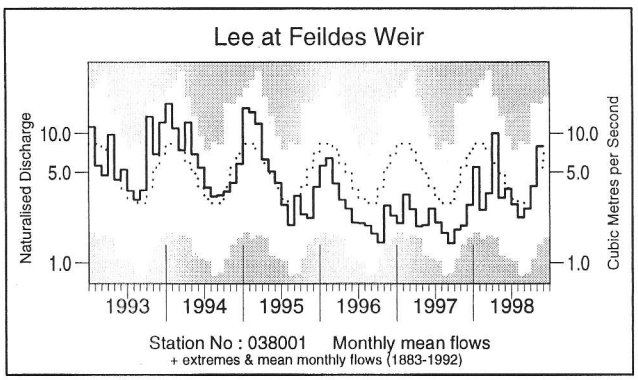


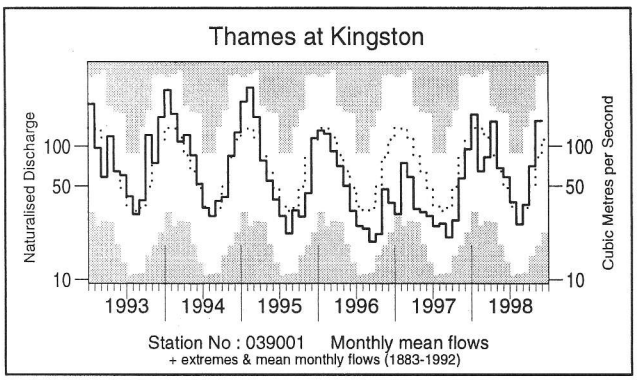








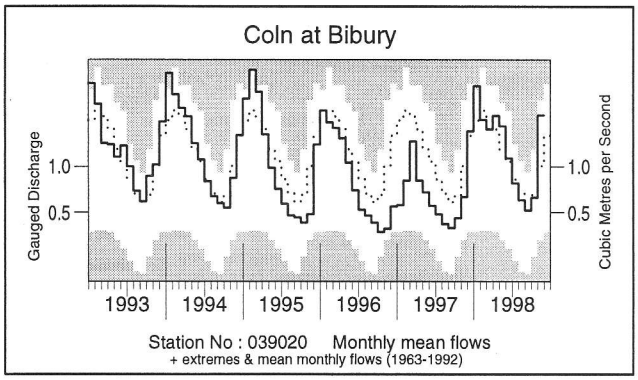


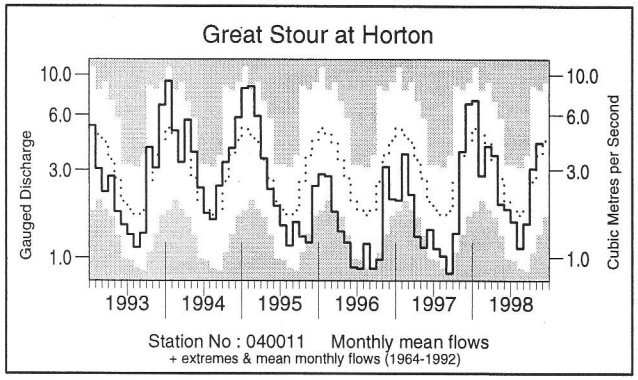


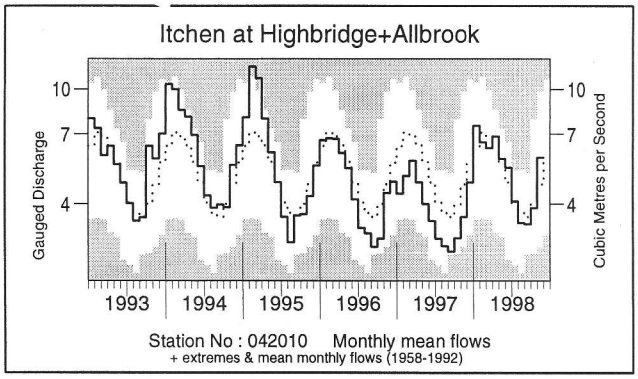
Monthly river flow hydrographs

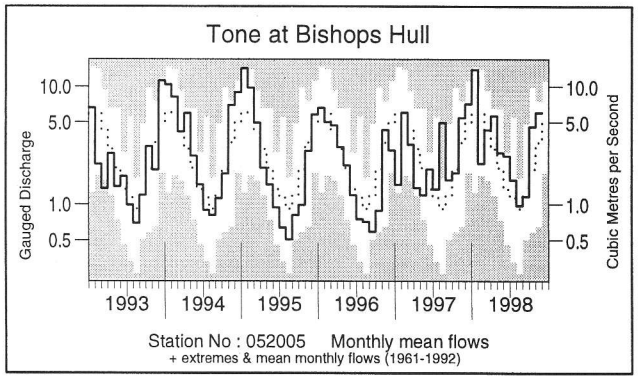
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1992 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded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

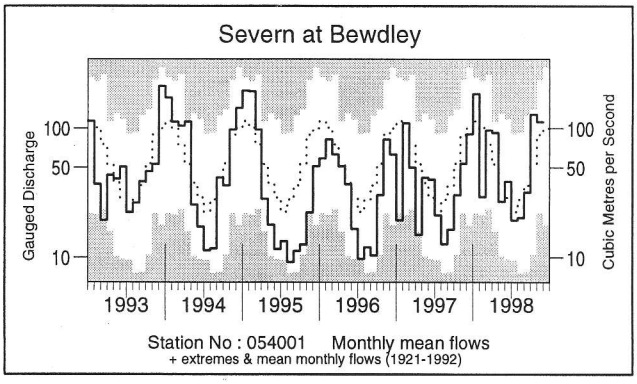
River flow . . . River flow . . .

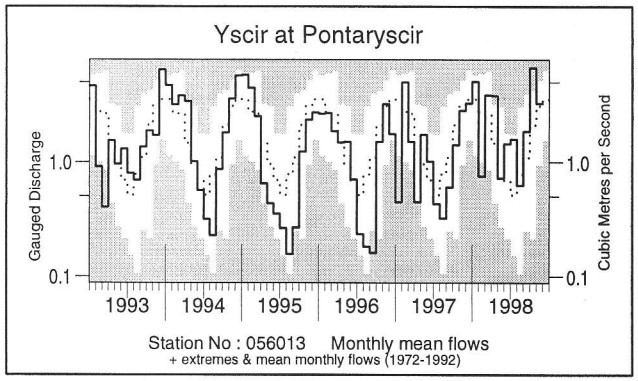


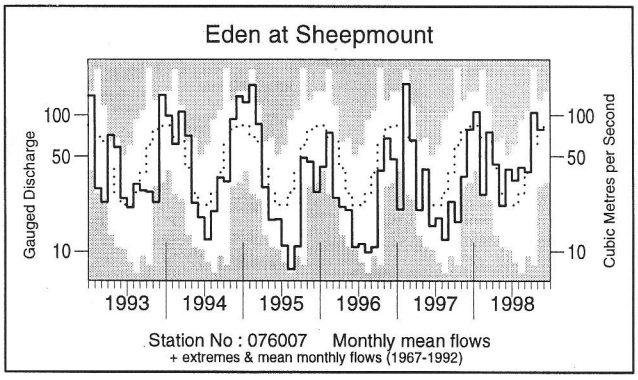


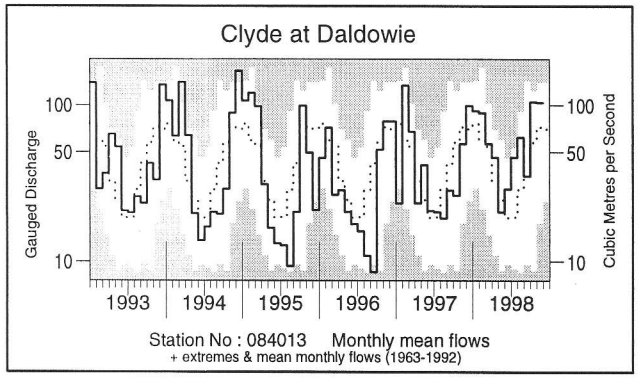










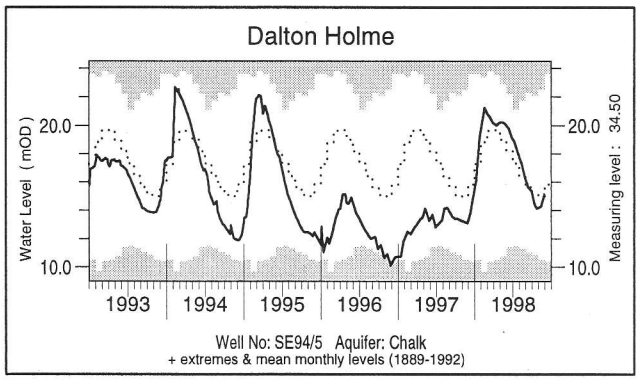


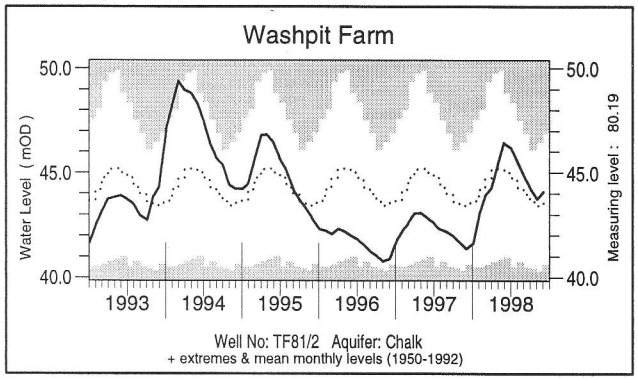
Notable runoff accumulations September 1998 - November 1998 (a); January 1998 - November 1998 (b)

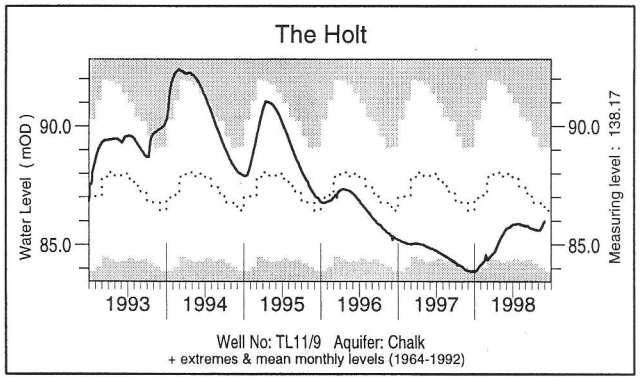
(a) River	%lta	Rank	(b) River	%lta	Rank	River	%lta	Rank
Tyne	229	33/33	Tyne	153	33/33	Cynon	146	39/39
Whiteadder	255	30/30	Tweed	130	38/38	Spey	118	44/46
Dove	180	37/37	Whiteadder	164	29/29	Dove	128	35/37
Yscir	157	26/26	Mole	131	23/23	Ouse	157	63/66
Cree	132	32/35	Tone	145	37/37	Exe	136	40/42
Exe	177	42/43	Yscir	152	26/26	Clyde	139	34/35

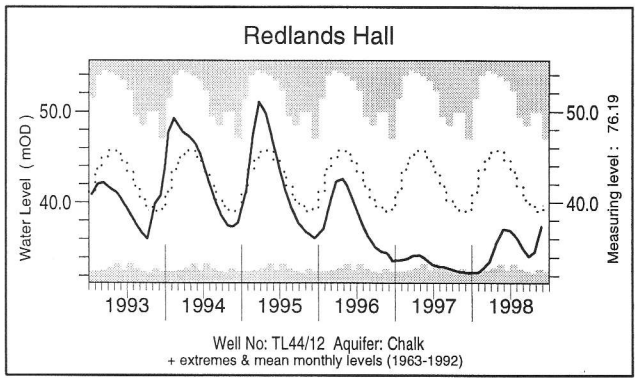
lta = long term average
Rank 1 = lowest on record

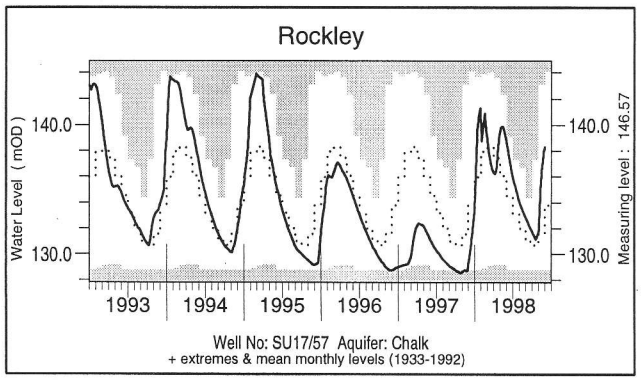
Groundwater . . . Groundwater

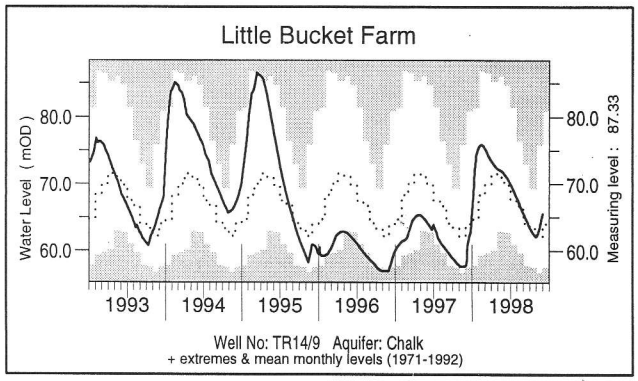


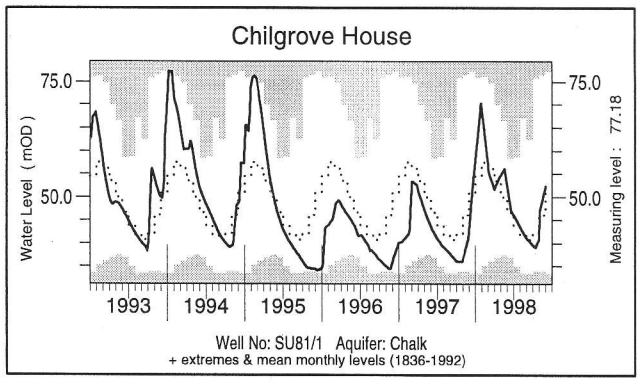


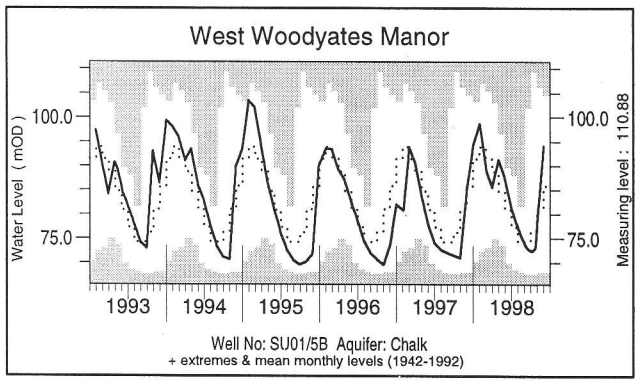








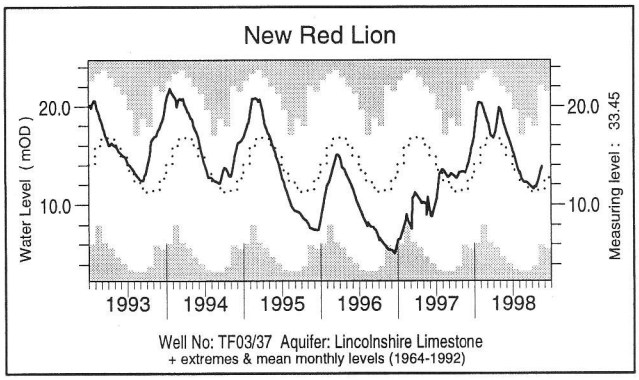


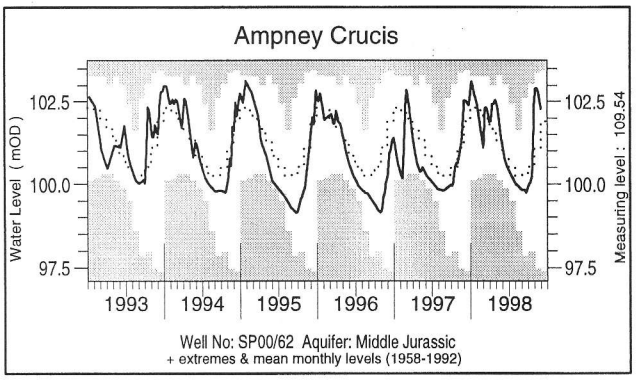


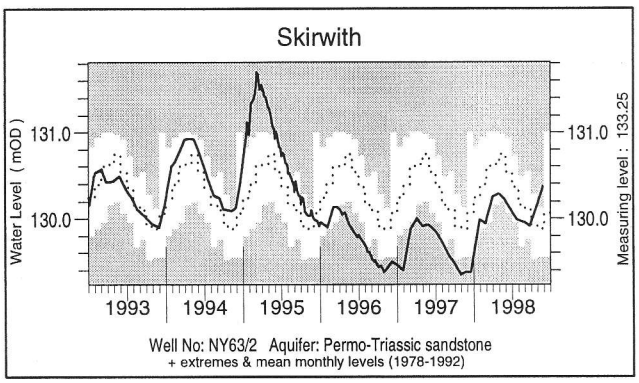
What is groundwater?

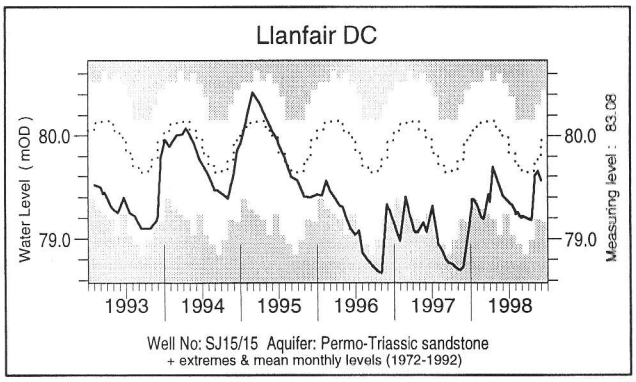
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment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

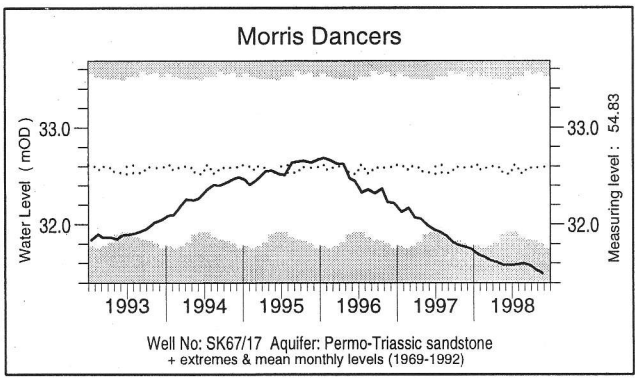
Groundwater . . . Groundwater

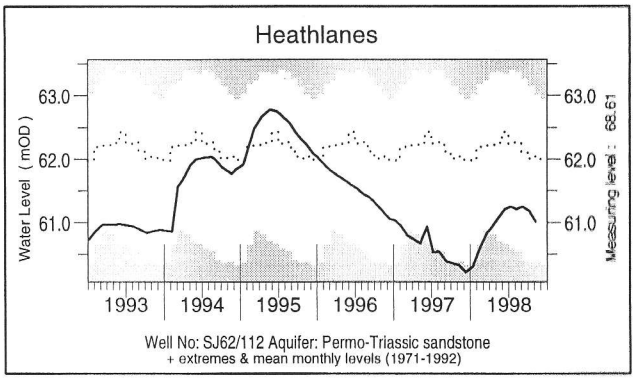


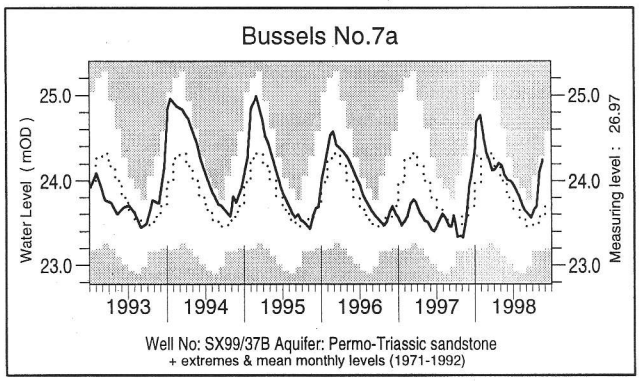


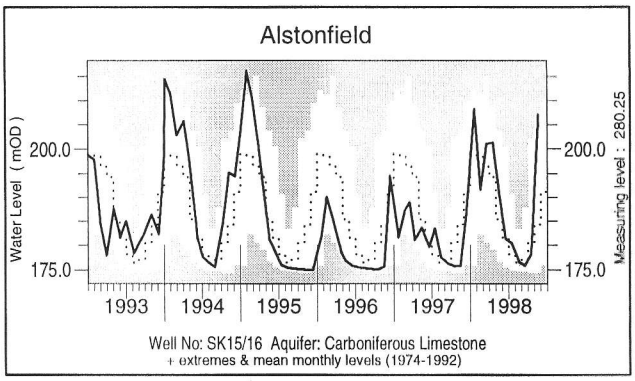












Groundwater levels November/December 1998

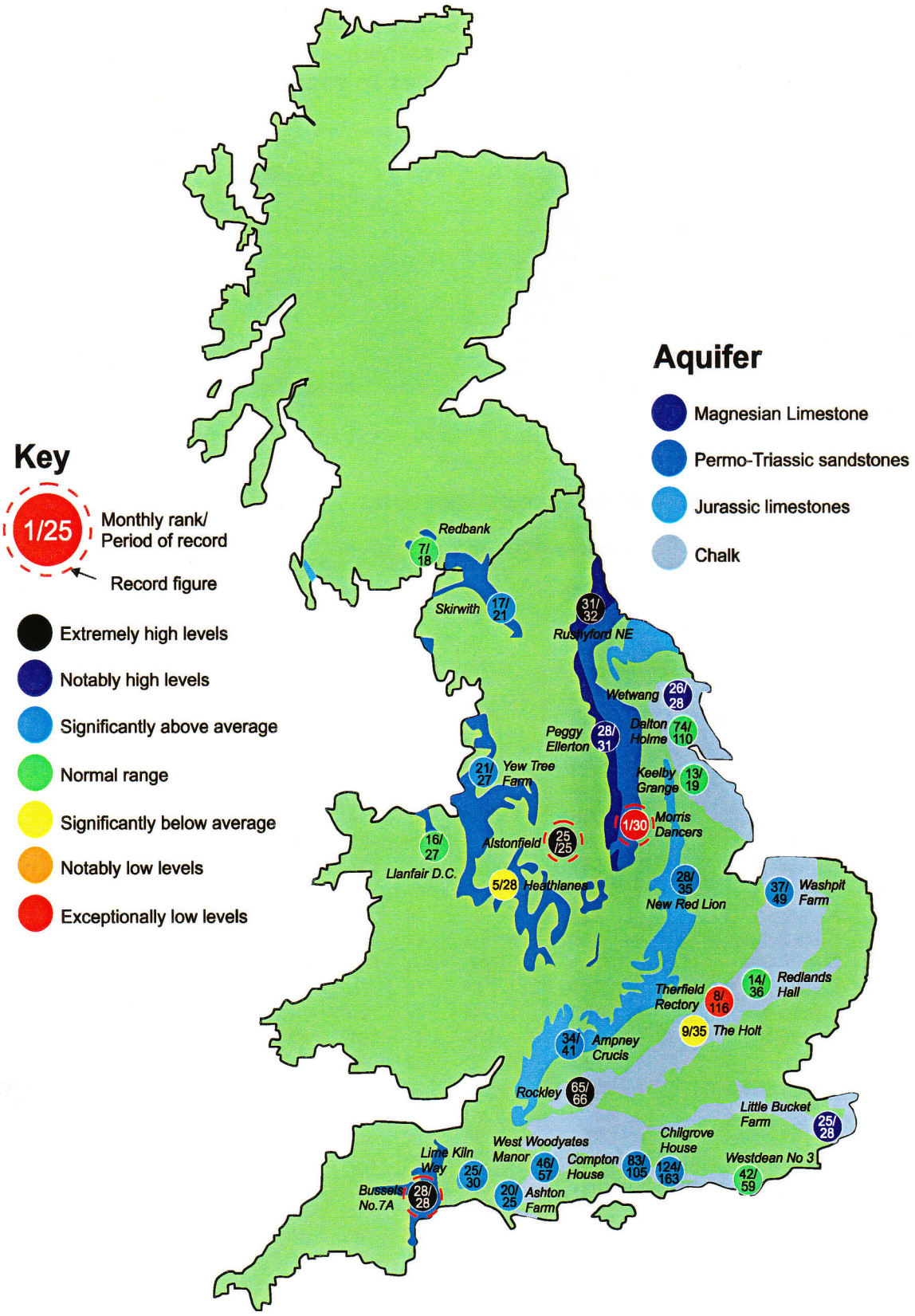
Borehole	Level	Date	Nov av.
Dalton Holme	15.11	27/11	14.79
Washpit Farm	44.10	2/12	43.17
The Holt	85.99	30/11	86.87
Redlands Hall	37.41	24/11	38.22
Ashton Farm	68.95	30/11	66.20
Little Bucket	65.60	30/11	62.32

Borehole	Level	Date	Nov av.
Chilgrove	52.36	30/11	46.50
W Woodyates	94.10	30/11	80.53
New Red Lion	13.84	18/11	11.66
Ampney Crucis	102.28	30/11	101.09
Skirwith	130.37	25/11	129.85

Borehole	Level	Date	Nov av.
Llanfair DC	79.56	30/11	79.55
Morris Dancers	31.50	23/11	32.48
Heathlanes	61.01	7/11	61.84
Bussels	24.25	19/11	23.57
Alstonfield	207.07	19/11	184.14

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

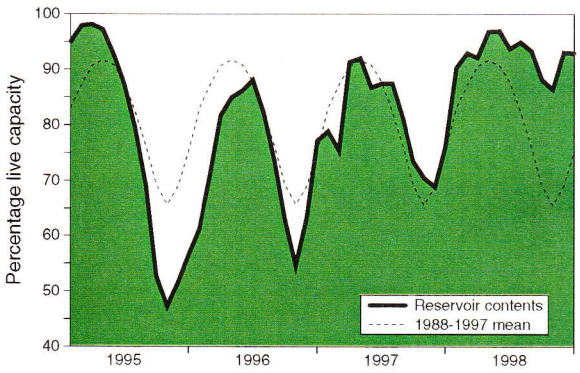


Groundwater levels - November 1998

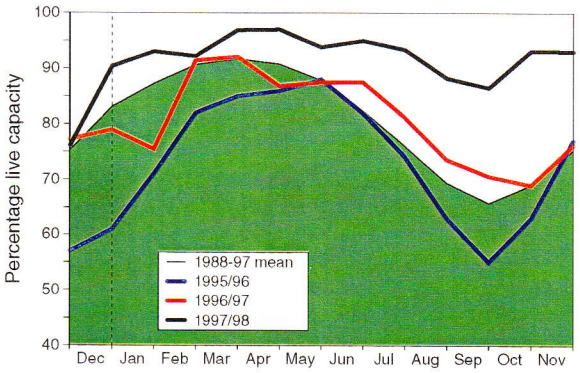
The rankings are based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record.

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)	1998 Jul	Aug	Sep	Oct	Nov	Dec	Min. Dec	Year* of min
NorthWest	N Command Zone	• 133375	85	84	80	75	90	93	44	1993
	Vyrnwy	55146	93	90	81	83	100	93	33	1995
Northumbrian	Teesdale	• 87936	90	90	92	87	99	98	39	1995
	Kielder	(199175)	(93)	(92)	(94)	(88)	(96)	(93)	(65)	1989
SevernTrent	Clywedog	44922	98	97	93	88	100	81	43	1995
	DerwentValley	• 39525	100	93	96	90	100	99	9	1995
Yorkshire	Washburn	• 22035	98	89	85	82	96	96	16	1995
	Bradford supply	• 41407	96	93	92	92	99	99	20	1995
Anglian	Grafham ***	58707	96	95	87	84	92	87	47	1997
	Rutland ***	130061	96	93	88	86	87	88	57	1995
Thames	London	• 206399	99	96	85	82	83	92	52	1990
	Farmoor	• 13843	98	96	97	98	96	93	52	1990
Southern	Bewl	28170	92	86	76	70	77	87	34	1990
	Ardingly	4685	100	96	74	67	80	100	44	1989
Wessex	Clatworthy	5364	92	87	77	70	92	100	37	1989
	BristolWW	• (38666)	(92)	(88)	(79)	(72)	(84)	(95)	(27)	1990
SouthWest	Colliford	28540	77	78	76	76	82	89	42	1995
	Roadford	34500	98	99	98	96	100	98	8	1989
	Wimbleball	21320	100	99	92	87	100	100	34	1995
	Stithians	5205	92	88	80	71	80	100	29	1990
Welsh	Celyn and Brenig	• 131155	100	100	84	95	100	96	50	1995
	Brianne	62140	99	100	100	97	100	94	72	1995
	Big Five ****	• 69762	98	97	88	94	92	86	49	1990
	Elan Valley	• 99106	98	98	96	97	100	100	47	1995
East of	Edinburgh/Mid Lothian	• 97639	54	51	45	43	50	56**	67	1997
Scotland	East Lothian	• 10206	100	100	99	100	100	100	43	1989
West of	Loch Katrine	• 111363	81	85	89	85	92	89	86	1997
Scotland	Daer	22412	95	98	87	81	99	100	87	1997
	LochThom	• 11840	90	100	98	97	100	100	82	1997

() gross storage • reservoir groups * last occurence ** Megget filling, work finished 2/10/98

*** Resurveying, revised capacity will be used from 1/1/99 **** Pumping to Llandegfedd reduced due to repairs

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 1988-1998 period only. In some gravity-fed reservoirs (eg. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

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 discontinuation of the CARP system used by the Met. Office to provide more definitive regional rainfall assessments means that the recent MORECS figures have not been updated. Negotiations are continuing with the Met. Office to provide more accurate areal figures. Until the negotiations are concluded the regional rainfall figures (and the return periods associated with them) should be regarded as a guide only.

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