

# Hydrological summary

## *for the United Kingdom*

### General

Following a wet beginning to the month - with some localised flooding - October was a warm and notably sunny month (the sunniest for 40 years in England and Wales) with rainfall totals appreciably below average throughout much of the UK. The limited rainfall after the 3<sup>rd</sup> stalled the seasonal recovery in river flows in most catchments. Nonetheless, reservoir stocks for England and Wales as a whole increased modestly and now stand substantially above the late autumn average. Groundwater levels in most major aquifers are close to, or above, average confirming the current healthy water resources outlook.

### Rainfall

The very unsettled weather of late September continued into October with heavy frontal rainfall affecting most regions between the 1<sup>st</sup> - 3<sup>rd</sup>; this wet spell was responsible for around half of the monthly rainfall in some western areas (including parts of Northern Ireland). Vigorous low pressure systems also crossed southern Britain on the 24<sup>th</sup> and 25<sup>th</sup>, with particularly damaging gales along the south coast (Weymouth reported 39 mm of rain on the 24<sup>th</sup>), and again around month end. Between these interludes anticyclonic conditions predominated and many 10 - 12 day sequences without rain were reported (e.g. in central southern England). Rainfall totals for October were generally well below average in northern Britain - some raingauges in the Central Valley of Scotland reported less than half of the 1961-90 average - and Northern Ireland registered its third driest October since 1962. Totals for much of England and Wales were closer to the monthly average, although parts of Cornwall were very dry whilst above average totals were again reported from the West Midlands. The late summer/early autumn period has been dry in much of Scotland, adding to a recent cluster of low July - October rainfall totals (including 1993, 1994 and 1997). Rainfall accumulations are well within the normal range however, for all regions in the May - October 1999 timeframe and above average in almost all regions for the year thus far.

### River flows

The month opened with spate conditions in many impermeable catchments but floodplain inundations, although common, were generally modest in extent; the Lune and Severn reported their second highest October flows in the last 15 and 11 years respectively. Further flood warnings were issued during the 24<sup>th</sup> - 26<sup>th</sup> (e.g. in the Trent, Dove and Severn basins); transport disruption was widespread and Spring tides added to the local flooding in southern England. This episode aside, sustained recessions characterised most rivers from early in October and flows in most western and northern rivers were significantly below average approaching month-end. North of the Humber monthly runoff totals were mostly below average, but modestly so except in a few responsive catchments

(e.g. the River Cree). However, above average flows were recorded in the eastern Grampian region. Near-average rainfall and an increasing baseflow contribution (in some areas) produced above average runoff in many spring-fed eastern and southern rivers. In the Cotswolds, the benefit of an early rise in groundwater levels helped establish a new maximum October runoff for the Coln. However, groundwater contributions remained modest in some eastern catchments (e.g. Lee basin, Medway and Great Stour) where October runoff totals were below average, as were accumulated runoff totals for the last six months. May - October runoff totals were generally unremarkable with no strong regional pattern; below average in south-east Scotland, above average in central England and parts of the South-West. In the 12-month timeframe runoff totals were mostly very healthy away from the South-East.

### Groundwater

Above average rainfall over the last three months in the English lowlands had encouraged a brisk decline in soil moisture deficits which now stand below average throughout most of the English Lowlands (exceptions are found in north Kent, parts of Cambridgeshire and the Vale of York). In the Chalk, seasonal recoveries were underway in the more westerly outcrops - upturns in groundwater levels were evident at West Woodyates and Chilgrove for example - whilst in the east levels were mostly tracking the normal mid-autumn recessions. October groundwater levels were well within the normal range throughout the Chalk. Soils were at, or close to, saturation in western and northern Britain and in Northern Ireland. Correspondingly, recoveries were well underway in most limestone outcrops where, again, most October levels were close to the seasonal norm. In the Permo-Triassic sandstones, the limited October rainfall arrested the recovery in the South-West (but levels remained notably high at Bussels). Healthy levels characterised most of the outcrop areas, except where recoveries were being generated from an exceptionally low base (e.g. at Morris Dancers).

October 1999

# Rainfall . . . Rainfall . . . Rainfall . .

## Rainfall accumulations and return period estimates

Area	Rainfall	Oct 1999	Aug 99-Oct 99 RP	May 99-Oct 99 RP	Jan 99-Oct 99 RP	Nov 98-Oct99 RP				
<b>England &amp; Wales</b>	<b>mm</b> <b>%</b>	<b>77</b> <b>91</b>	<b>294</b> <b>124</b>	<b>5-10</b> <b>104</b>	<b>448</b> <b>2-5</b>	<b>750</b> <b>105</b>	<b>2-5</b> <b>102</b>	<b>915</b> <b>2-5</b>		
North West	mm %	102 80	335 96	2-5	557 94	2-5	982 103	2-5	1206 100	<2
Northumbrian	mm %	54 71	227 99	<2	425 102	2-5	727 106	2-5	884 104	2-5
Severn Trent	mm %	78 122	284 145	10-20	432 118	5-10	736 121	10-15	867 115	5-10
Yorkshire	mm %	68 94	233 108	2-5	402 102	2-5	714 108	2-5	851 104	2-5
Anglian	mm %	58 115	227 146	10-20	364 120	5-10	564 117	5-10	688 115	5-10
Thames	mm %	58 93	264 147	10-20	407 120	5-10	622 112	2-5	755 110	2-5
Southern	mm %	67 84	284 138	5-15	398 110	2-5	636 104	2-5	792 102	2-5
Wessex	mm %	72 91	306 141	5-15	441 114	2-5	740 112	2-5	903 108	2-5
South West	mm %	70 61	312 107	2-5	474 94	2-5	892 98	2-5	1165 99	2-5
Welsh	mm %	131 96	460 130	5-10	651 110	2-5	1167 115	5-10	1426 109	2-5
<b>Scotland</b>	<b>mm</b> <b>%</b>	<b>114</b> <b>73</b>	<b>333</b> <b>80</b>	<b>5-10</b>	<b>642</b> <b>94</b>	<b>2-5</b>	<b>1227</b> <b>108</b>	<b>2-5</b>	<b>1565</b> <b>109</b>	<b>2-5</b>
Highland	mm %	161 81	403 81	2-5	761 96	2-5	1550 114	5-10	1959 111	5-10
North East	mm %	83 85	243 90	2-5	455 95	2-5	763 98	2-5	957 98	2-5
Tay	mm %	99 76	323 96	2-5	595 104	2-5	1094 111	2-5	1378 112	5-10
Forth	mm %	75 65	237 74	5-10	516 96	2-5	899 101	2-5	1185 107	2-5
Tweed	mm %	57 60	218 80	2-5	449 93	2-5	784 100	<2	992 102	2-5
Solway	mm %	84 53	321 77	5-10	651 96	2-5	1207 107	2-5	1559 110	2-5
Clyde	mm %	126 65	377 75	5-10	726 91	2-5	1398 105	2-5	1801 106	2-5
<b>Northern Ireland</b>	<b>mm</b> <b>%</b>	<b>51</b> <b>45</b>	<b>321</b> <b>106</b>	<b>2-5</b>	<b>499</b> <b>98</b>	<b>2-5</b>	<b>854</b> <b>100</b>	<b>&lt;2</b>	<b>1071</b> <b>101</b>	<b>2-5</b>

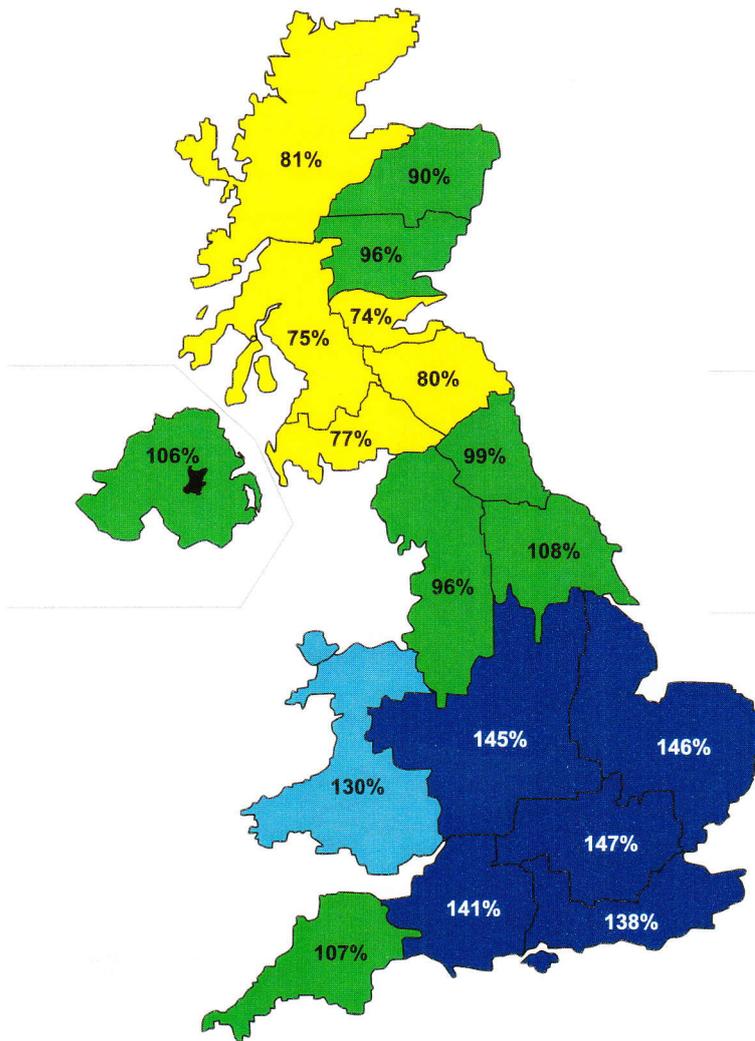
RP = Return period

The monthly rainfall figures\* are copyright of The Met. Office and may not be passed on to any unauthorised person or organisation. All monthly totals since July 1998 are provisional (see page 12). Recent monthly rainfall figures for the Scottish regions have been 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); 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 England & Wales and Scotland rainfall series can exaggerate the relative wetness of the recent past. \*See page 12.

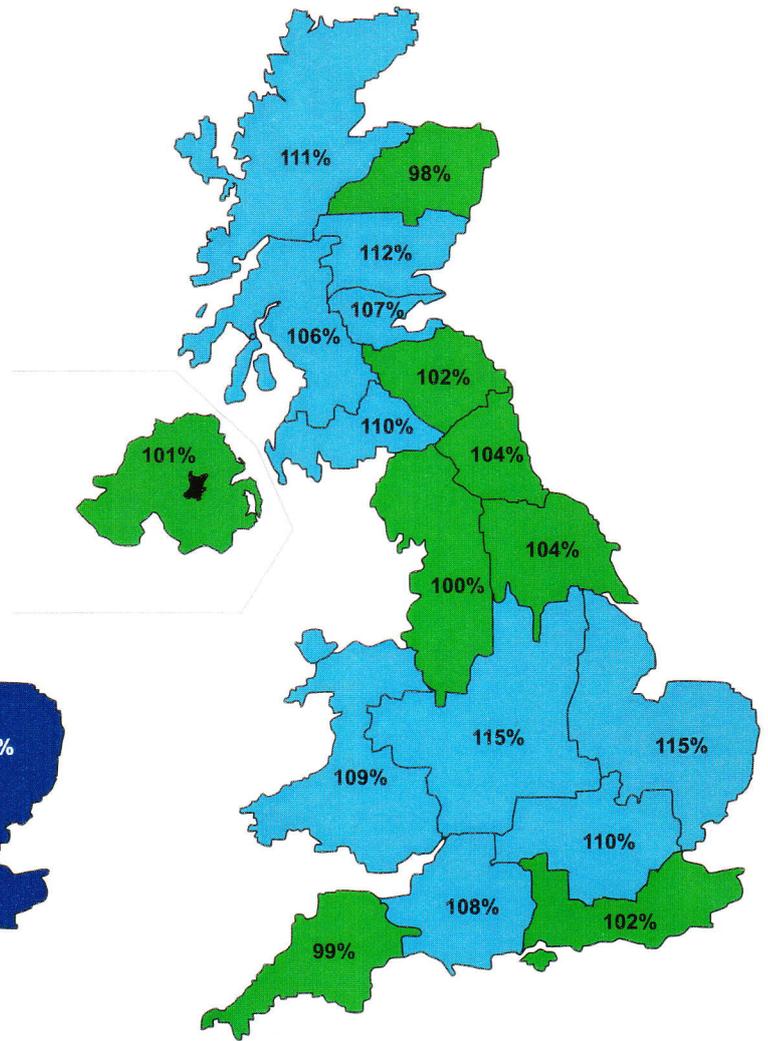
# Rainfall... Rainfall... Rainfall

## Key

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



**August 1999 - October 1999**

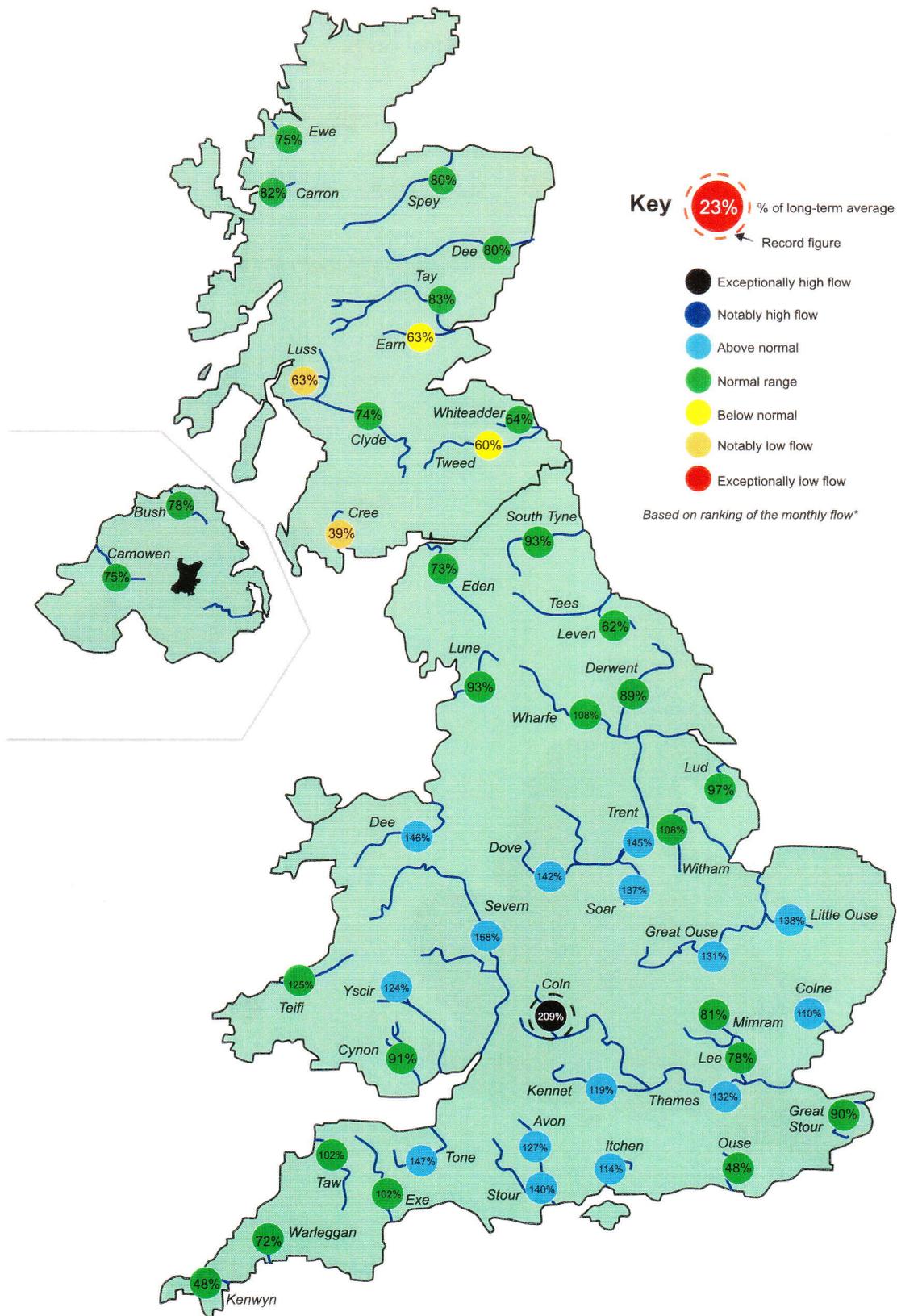


**November 1998 - October 1999**

## Rainfall accumulation maps

The UK rainfall total for October was about 20% below average and since May only September has exceeded the 1961-90 mean. However, notwithstanding the relatively dry August-October period in much of Scotland, rainfall for the year thus far is considerably above the average, adding to the cluster of high January-October totals in the recent past - 1998 and 1988 being exceptionally wet.

# River flow . . . River flow . . .

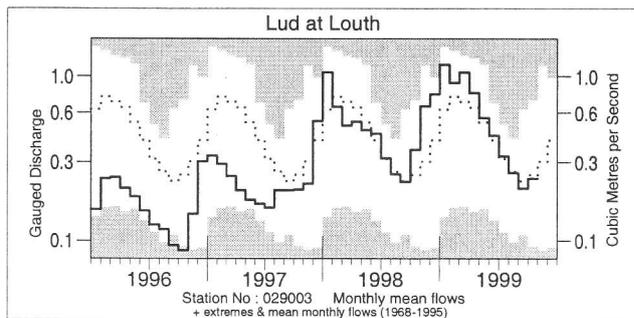
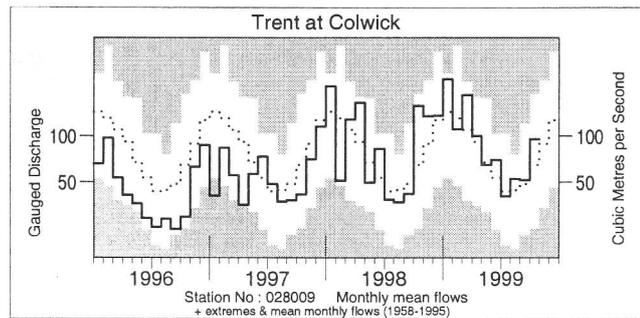
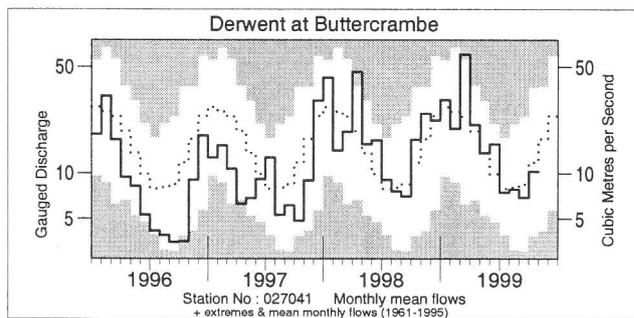
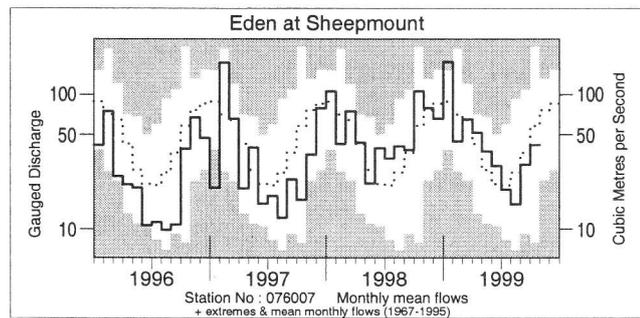
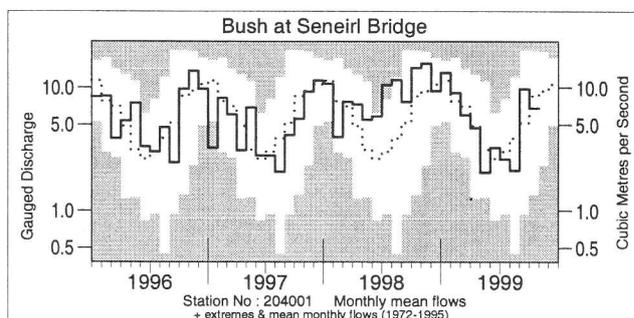
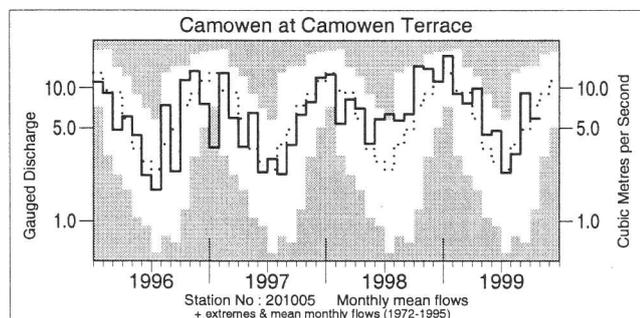
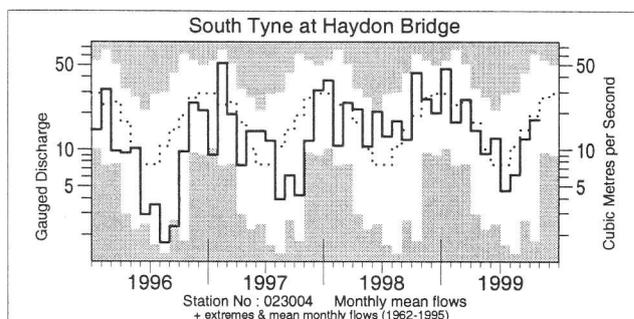
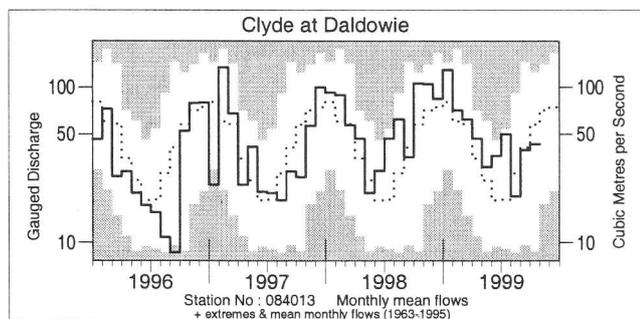
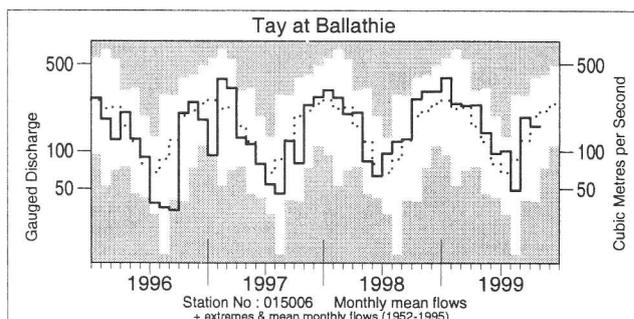
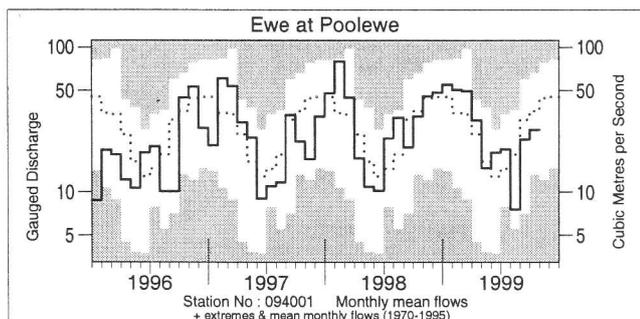


## River flows - October 1999

\*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.

# River flow . . .

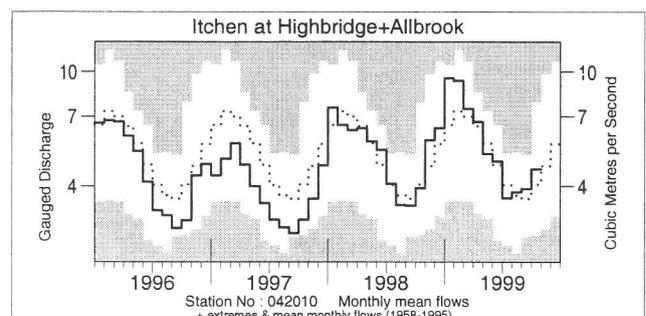
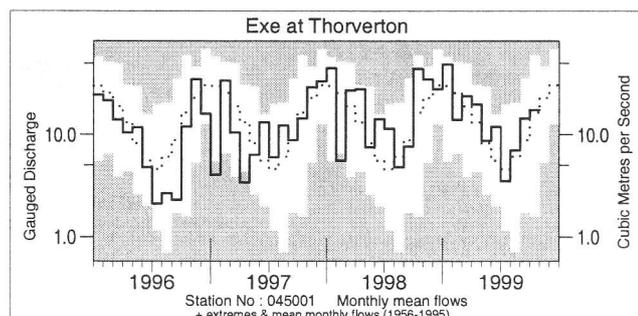
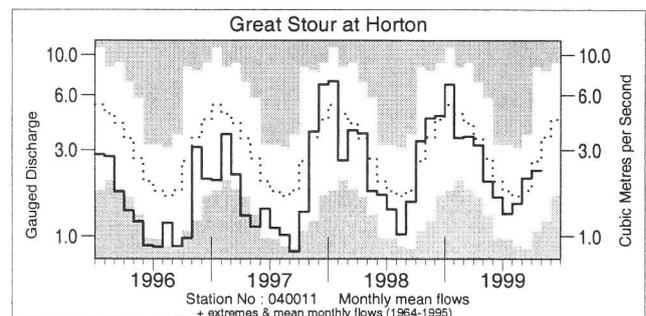
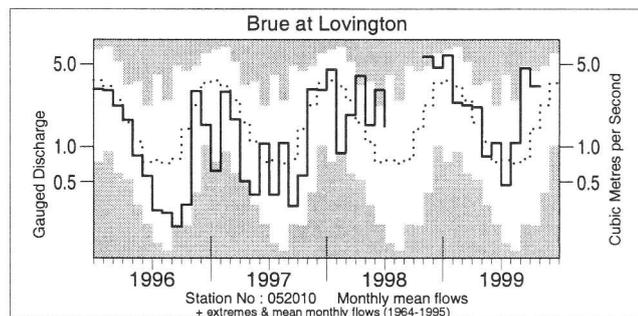
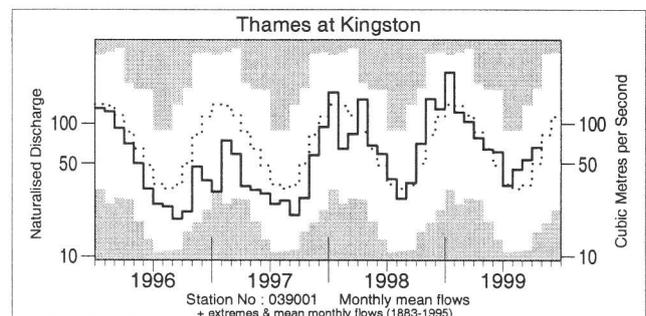
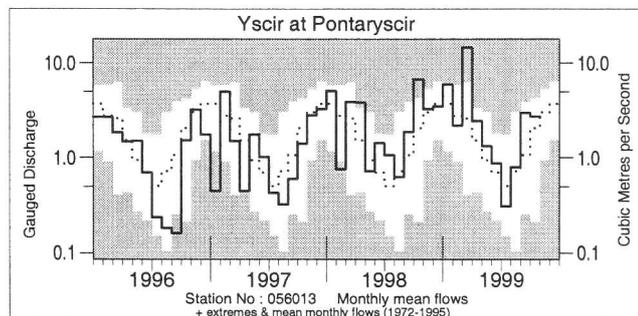
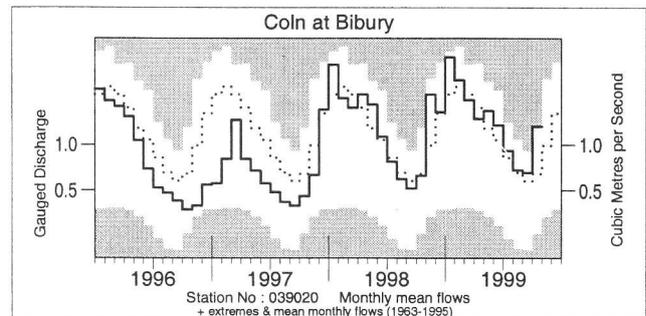
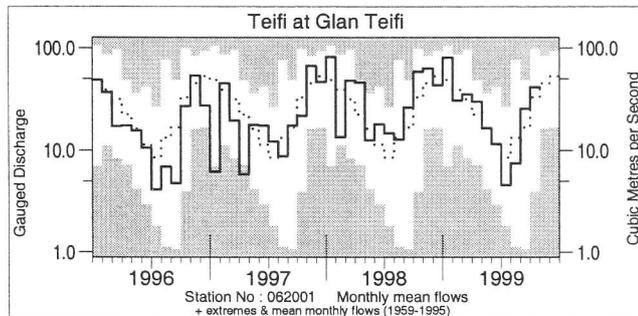
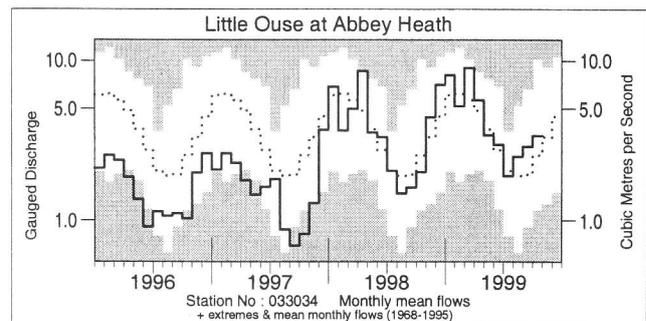
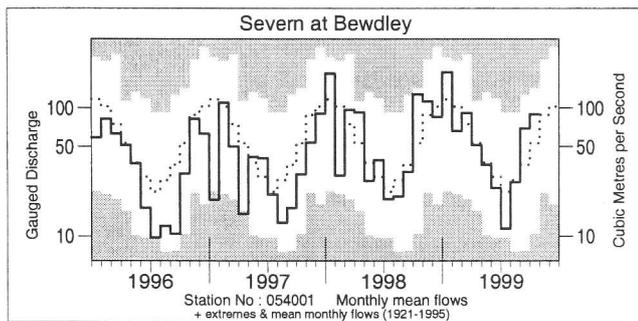
# River flow . . .



## 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 1996 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

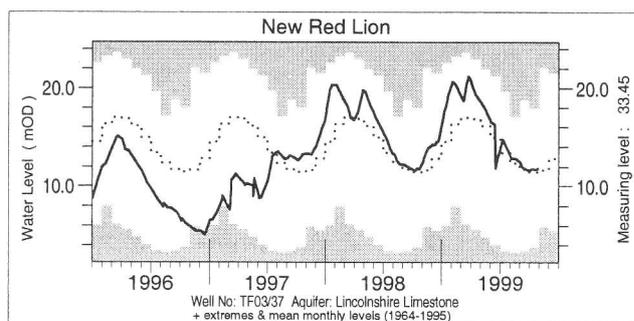
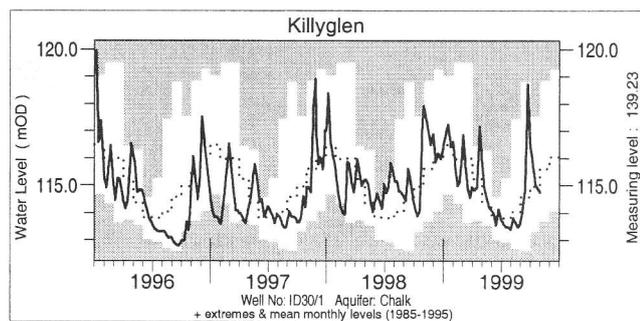
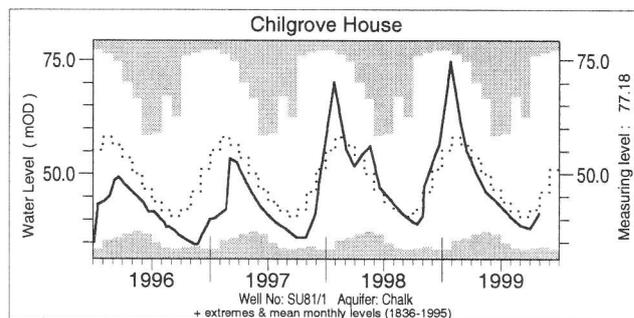
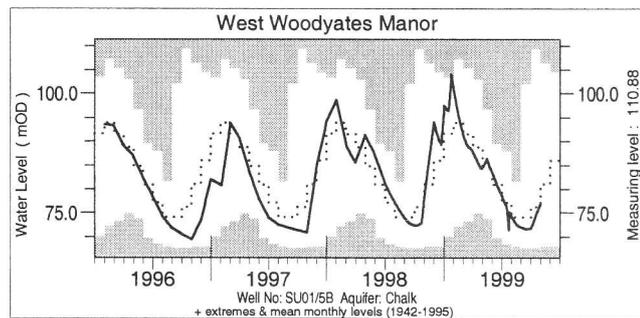
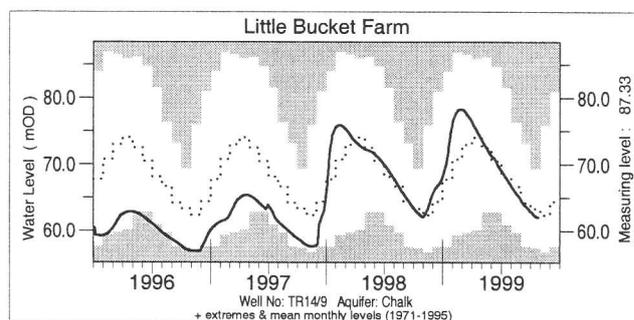
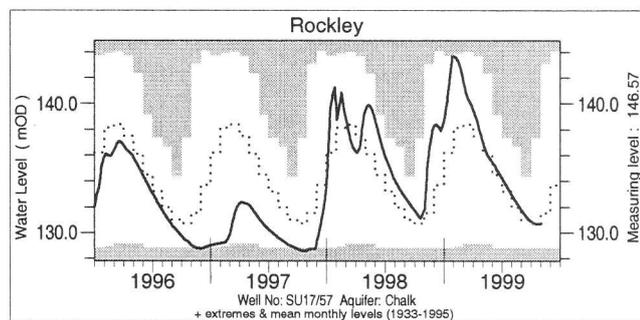
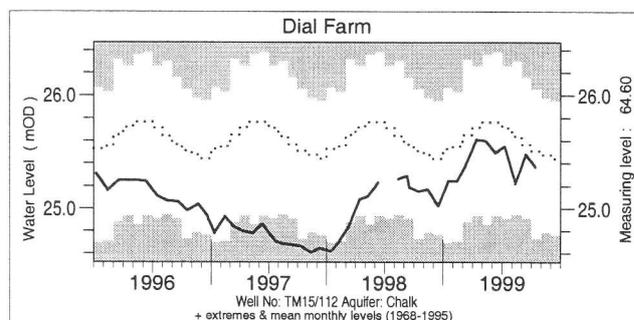
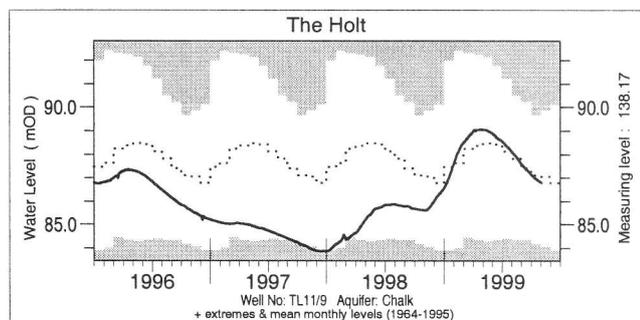
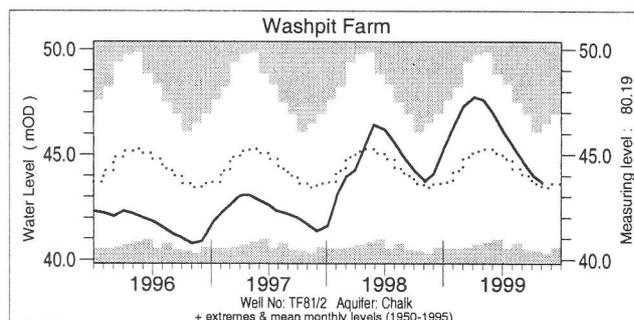
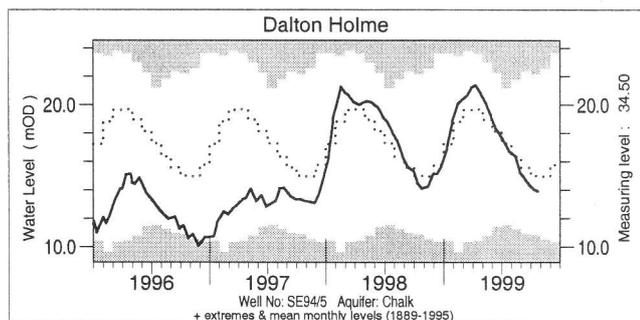
# River flow . . . River flow . . .



## Notable runoff accumulations July 1999 - October 1999 (a); November 1998 - October 1999 (b)

(a) River	%lta	Rank	(b) River	%lta	Rank	River	%lta	Rank
Colne	174	38/40	Trent	127	40/41	Brue	155	34/34
Brue	250	33/34	Witham	159	38/40	Yscir	169	26/26
Carron	80	4/21	Coln	127	35/36	Camowen	119	25/26

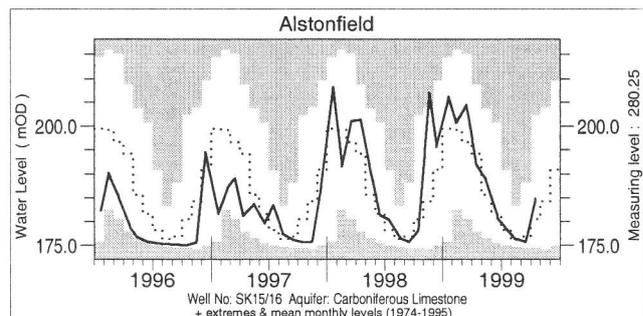
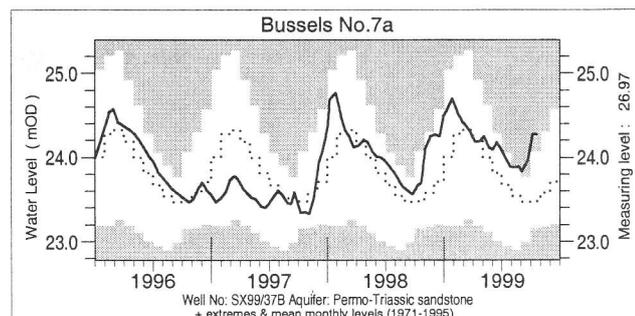
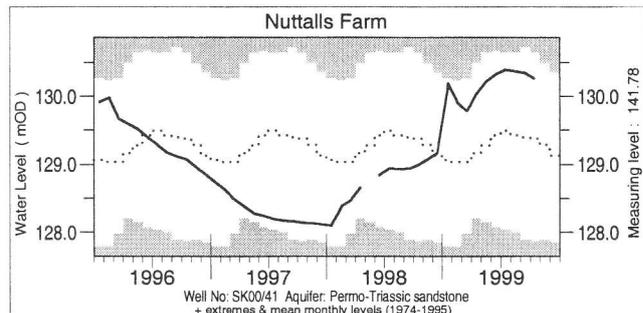
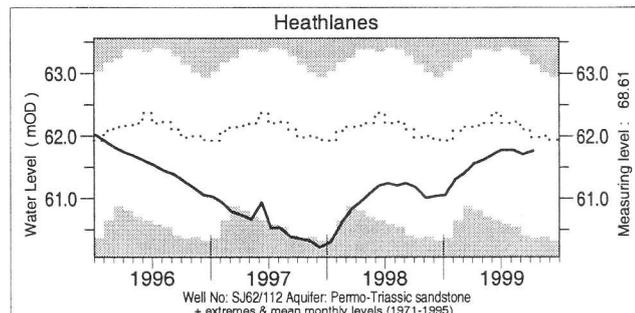
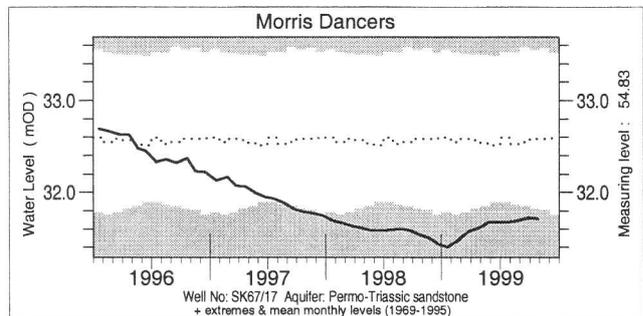
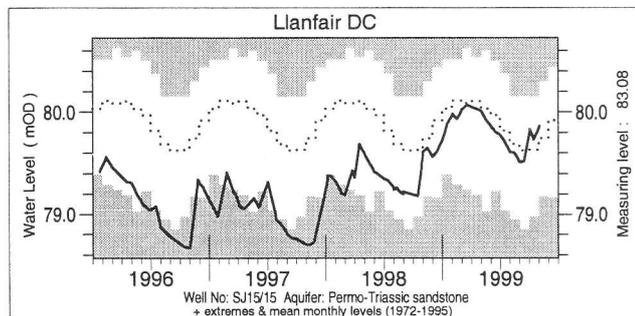
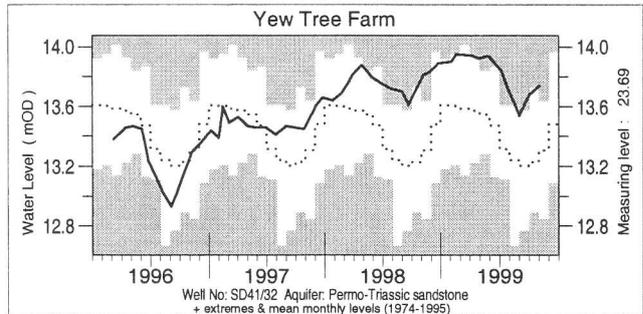
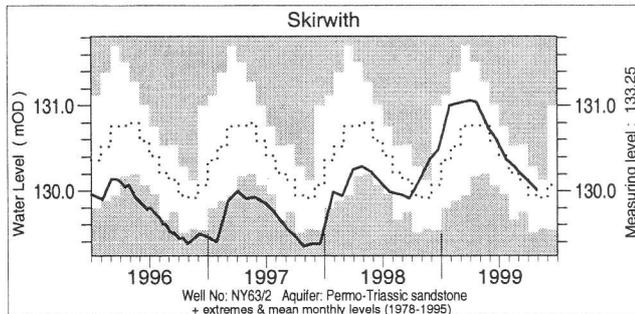
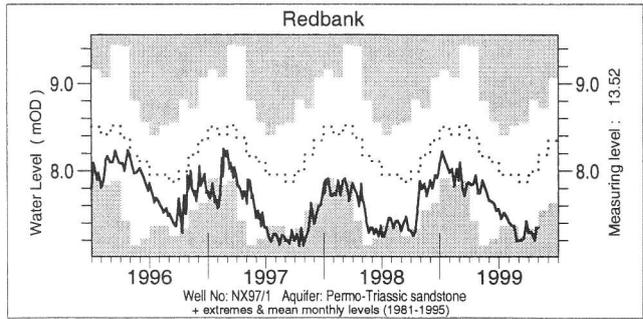
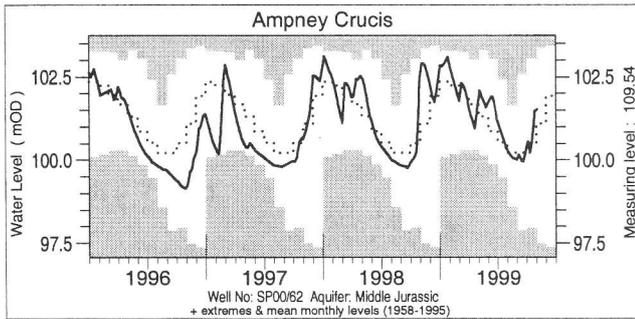
# Groundwater . . . Groundwater



## 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

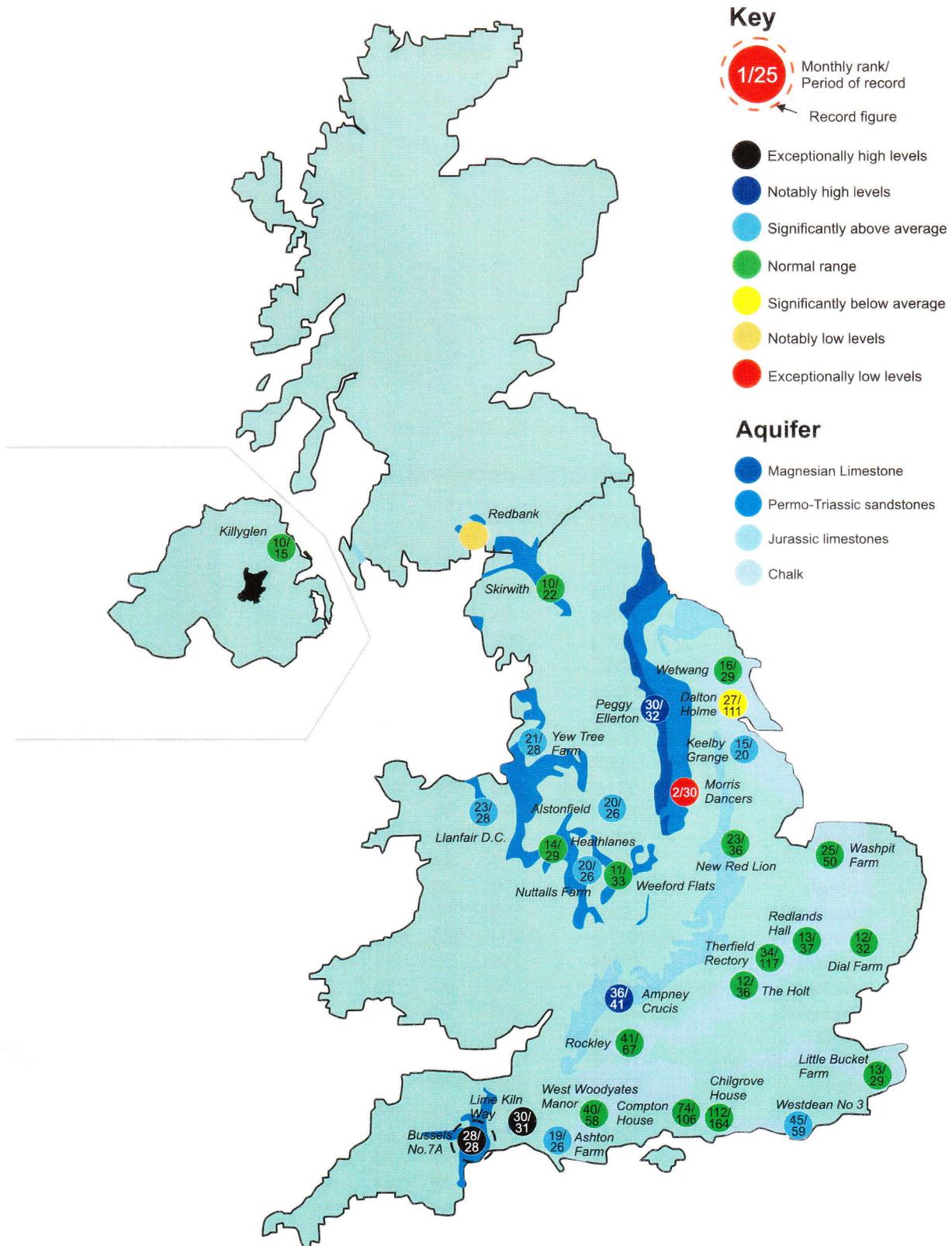


## Groundwater levels October/November 1999

Borehole	Level	Date	Oct av.	Borehole	Level	Date	Oct av.	Borehole	Level	Date	Oct av.
Dalton Holme	13.91	22/10	14.91	Chilgrove	41.41	29/10	42.43	Llanfair DC	79.86	01/11	79.46
Washpit Farm	43.67	02/11	43.41	Killyglen	114.75	31/10	114.52	Morris Dancers	31.71	25/10	32.48
The Holt	86.78	01/11	86.96	New Red Lion	11.83	27/10	11.39	Heathlanes	61.77	11/10	61.89
Dial Farm	25.37	12/10	25.45	Ampney Crucis	101.52	01/11	100.41	Nuttalls Farm	130.26	12/10	129.38
Rockley	130.71	01/11	130.66	Redbank	7.35	31/10	7.97	Bussels No. 7A	24.27	19/10	23.49
Little Bucket	62.08	25/10	63.18	Skirwith	130.01	27/10	129.87	Alstonfield	184.79	15/10	179.95
West Woodyates	77.17	31/10	75.29	Yew Tree Farm	13.74	02/11	13.27				

Levels in metres above Ordnance Datum

# Groundwater . . . Groundwater

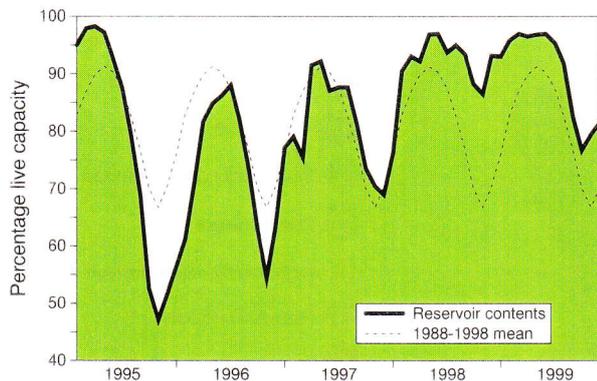


## Groundwater levels - October 1999

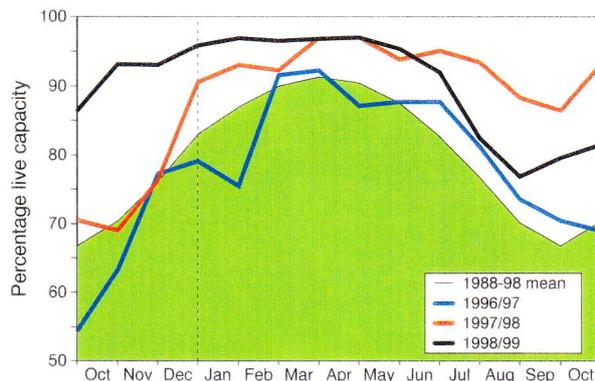
The rankings are normally based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. 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 (MI)	1999							Min. Nov	Year*
			Jun	Jul	Aug	Sep	Oct	Nov			
North West	N Command Zone	• 133375	94	81	71	56	60	57	38	1993	
	Vyrnwy	• 55146	96	87	82	66	81	76	25	1995	
Northumbrian	Teesdale	• 87936	94	86	69	61	66	68	33	1995	
	Kielder	(199175)	(95)	(93)	(89)	(88)	(88)	(86)	(63)	1989	
Severn Trent	Clywedog	• 44922	99	98	82	83	88	82	38	1995	
	Derwent Valley	• 39525	95	90	79	69	64	85	15	1995	
Yorkshire	Washburn	• 22035	96	92	83	74	74	72	15	1995	
	Bradford supply	• 41407	94	90	77	67	76	77	16	1995	
Anglian	Grafham	** (55490)	(96)	(93)	(88)	(89)	(89)	(92)	(44)	1997	
	Rutland	** (116580)	(92)	(88)	(83)	(82)	(79)	(81)	(59)	1995	
Thames	London	• 206399	93	95	89	85	79	79	46	1996	
	Farmoor	• 13843	96	99	97	97	95	93	53	1990	
Southern	Bewl	• 28170	92	84	74	66	61	58	33	1990	
	Ardingly	• 4685	99	92	81	61	57	63	33	1996	
Wessex	Clatworthy	• 5364	98	95	75	75	75	87	19	1989	
	Bristol WW	• (38666)	(91)	(88)	(76)	(76)	(77)	(89)	(24)	1990	
South West	Colliford	• 28540	100	99	92	84	81	81	42	1996	
	Roadford	• 34500	93	93	90	87	91	91	18	1995	
	Wimbleball	• 21320	100	99	88	79	81	83	26	1995	
	Stithians	• 5205	98	96	86	77	70	63	18	1990	
Welsh	Celyn and Brenig	• 131155	100	100	83	79	86	88	48	1989	
	Brienne	• 62140	100	100	91	87	100	98	57	1995	
	Big Five	• 69762	96	92	74	68	87	90	41	1995	
	Elan Valley	• 99106	98	92	81	70	77	99	37	1995	
East of Scotland	Edinburgh/Mid Lothian	• 97639	82	82	80	71	71	73	50	1998	
	East Lothian	• 10206	97	98	94	93	86	90	48	1989	
West of Scotland	Loch Katrine	• 111363	95	94	89	74	92	92	76	1997	
	Daer	• 22412	100	91	87	73	80	93	70	1997	
Northern Ireland	Loch Thom	• 11840	93	89	90	75	82	73	73	1999	
	Silent Valley	• 20634	82	67	58	56	71	69	34	1995	

( ) figures in parentheses relate to gross storage \* denotes reservoir groups \*\*last occurrence \*\* updated gross capacity

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 1988-1999 period only (except for West of Scotland where data commence in 1994). 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 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), 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 IH) 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. Since the discontinuation of The Met. Office's CARP system in July 1998, rainfall figures have been provided by differing methods. Initial rainfall estimates for Scotland and the Scottish regions were derived by IH in collaboration with SEPA. In England and Wales, between July 1998 and May 1999, provisional rainfall figures derive from MORECS\*. Beginning with the June 1999 report, provisional rainfall figures for England and Wales, the EA regions and Northern Ireland (from January 1999) have been derived by the National Climate Information Centre (NCIC), formerly the UK Climate

Studies Group, at The Met. Office. However, readers should note that the MORECS estimates have not been updated since July 1998. Negotiations are continuing with The Met. Office to provide more accurate areal figures and as a result, from October 1999, the rainfall estimates for the Scottish regions are derived by NCIC in a pilot collaboration with IH and SEPA. Until the negotiations are concluded the regional rainfall 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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The cooperation of all data suppliers is gratefully acknowledged.

## Subscription

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