Note : much of the hydrometric data featured in this report is provisional; the Foot and Mouth outbreak has also restricted the amount of data available.

Hydrological summary for the United Kingdom

February 2001

General

February was decidedly wintry, particularly in northern Britain which experienced severe blizzard conditions. Nationally, precipitation totals fell considerably short of those registered in the autumn and early winter months, but the monthly average was exceeded once again. Accumulated rainfall totals are remarkably high and the resulting abundance of runoff and recharge has established a major new hydrological benchmark, for England and Wales especially. Most catchments remained close to saturation through February and Flood Watches were again common. Spate conditions have been remarkably persistent in the English lowlands; in part, this reflects unprecedented groundwater levels. Groundwater flooding was extensive and - by its nature – protracted, causing problems in areas remote from the low-lying floodplains. Reservoir contents remain close to capacity and the water resources outlook is very healthy, but the flood risk will remain high until accelerating evaporation rates help to dry out sodden catchments.

Rainfall

Rigorous frontal systems continued to track across the UK in early February – the 7/8th was especially wet (Folkestone reported 55 mm in 24 hours) - but high pressure became more dominant in mid-month and, with synoptic patterns favouring precipitation in eastern regions, rainfall in the west was modest thereafter. Provisional February rainfall totals exceed twice the monthly average in parts of north-east and south-east England; in the latter region some localities had their wettest February since 1951. By contrast parts of Northern Ireland (e.g. around Lough Neagh), and western Scotland reported less than 70%. Away from these regions, winter (Dec-Feb) rainfall totals are considerably above average – notably so in most of southern Britain. Significantly in relation to the hydrological conditions of the last six months, the Sept-Feb total for the UK was the second highest (after 1994/95) in a series from 1900. Even more notably, the corresponding provisional total for England and Wales, has been exceeded (for *any* six month period) only during the winter of 1960/61 over the last 120 years. Six-month rainfall totals in the English lowlands are remarkable. Many areas in the South-East registered their sixth successive month with well above average rainfall. Over the Thames catchment, the Sept-Feb total vies with 1903 (May-Oct) as the wettest 6-month sequence in a series from 1883. For catchments with areal rainfall records beginning in the last 40 years (a substantial majority), the abundance of rainfall has no recorded precedent. Large areas of the South-East have now received more than their annual average rainfall since the beginning of September 2000.

River Flows

Limited precipitation, and the frozen condition of some upland catchments, contributed to modest runoff in parts of western Scotland and Northern Ireland during February. Elsewhere, runoff was generally well above average with further notable flood events adding to a remarkable cluster. Flooding returned to the South-East on the 8/9th (e.g. on the Cuckmere in E. Sussex) and the Thames (at Kingston) registered its third separate event in the last four months with a return period of five or more years – a unique circumstance in a record from 1883. February runoff totals were extraordinarily high in many lowland rivers fed largely from groundwater. The Mimram reported its highest runoff for any month in a series from 1952, the Lee exceeded its previous February maximum in a 118-year record and runoff in most lowland rivers was close to the maximum. The even more outstanding 3- and 6-month runoff accumulations emphasise the singular nature of the hydrological conditions over the last half-year. The Dec-Feb runoff for the Itchen is substantially greater than any preceding 3-month accumulation and runoff since the beginning of September exceeds the mean annual average in over 80% of the index catchments across E&W; it is approaching twice the annual average in some responsive catchments in the South-East (e.g the Mole). More than 40% of gauging stations (in E&W) are estimated to have eclipsed previous maximum flows over the last six months and the frequency of flood events has been without modern precedent.

Groundwater

In percentage terms, the highest rainfall in February generally favoured the outcrop areas of the major aquifers; to an extent this is also true of the entire recharge season thus far. The unusual rainfall distribution (and its magnitude) is reflected in the autumn and winter effective rainfall totals – these are between three and four times the average in parts of the eastern and southern Chalk. Rapid drainage from high level springs and seepages has reduced groundwater levels in some of the more responsive aquifer units but, in the east particularly, the lagged water-table response to the late 2000 infiltration has rapidly gathered momentum. Recoveries have been dramatic at Therfield and Little Bucket which is thought to have overflowed for the first time in February. Many Chalk wells and boreholes (including Redlands, Stonor Park and Lime Kiln Way) exceeded their previous maxima (for any month) during February. Unprecedented levels were also reported for the Permo-Triassic sandstones (e.g. at Heathlanes and Nuttalls Farm), and levels remain above previous maxima in the Magnesian Limestone (Peggy Ellerton). Several recent winters (e.g. 1989/90, 1993/94 and 1994/95) have seen exceptionally high groundwater levels but the extent and persistence of 'clear-water' flooding and the magnitude of spring outflows sets 2000/2001 apart – the historical range of recorded groundwater level variation has been extended in many areas over the last few months.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

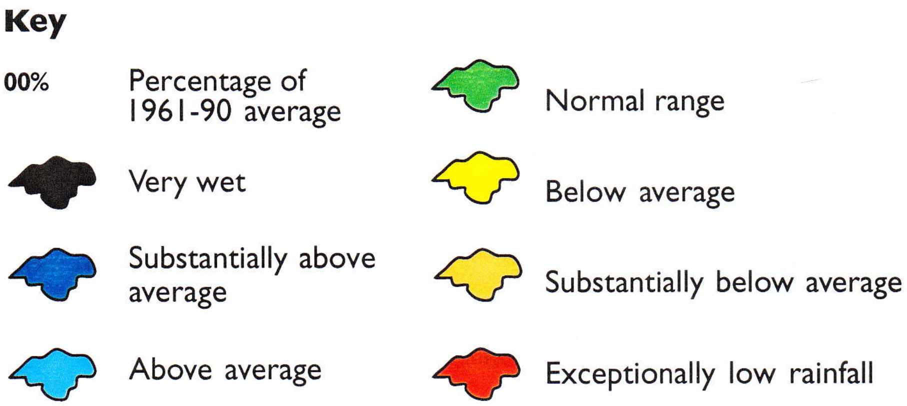
Rainfall accumulations and return period estimates

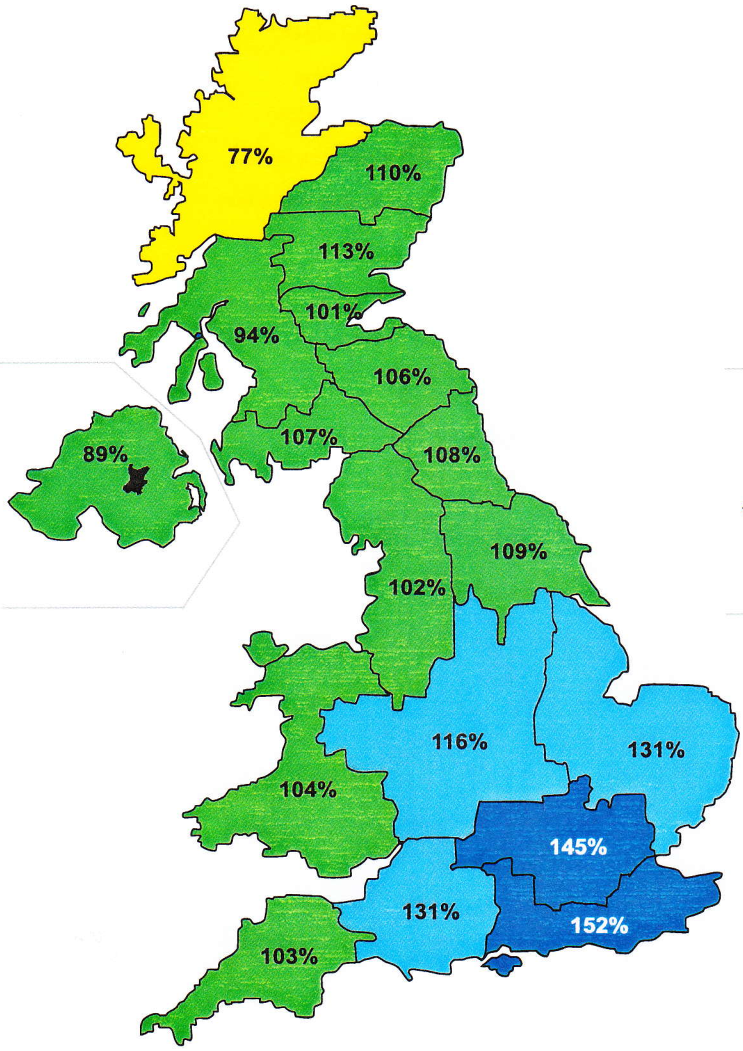
Area	Rainfall	Feb 2001	Dec 00-Feb 01	RP	Sep 00-Feb 01	RP	Jun 00-Feb 01	RP	Mar 00-Feb 01	RP
England & Wales	mm	**89**	**283**		**747**		**918**		**1161**	
	%	**141**	**115**	**2-5**	**150**	**120-170**	**131**	**35-50**	**130**	**50-80**
North West	mm	110	330		995		1276		1522	
	%	141	102	2-5	144	50-80	133	35-50	127	30-40
Northumbrian	mm	100	243		646		844		1076	
	%	169	108	2-5	141	35-50	127	15-25	126	25-40
Severn Trent	mm	75	233		617		768		997	
	%	139	116	2-5	154	120-170	133	25-40	132	40-60
Yorkshire	mm	93	240		684		868		1111	
	%	160	109	2-5	155	120-170	137	40-60	135	80-120
Anglian	mm	74	187		494		611		813	
	%	201	131	5-10	165	>>200	134	35-50	136	80-120
Thames	mm	83	259		640		756		994	
	%	184	145	10-15	175	>>200	143	70-100	144	>200
Southern	mm	102	328		840		954		1216	
	%	189	152	15-25	187	>>200	157	>>200	156	>>200
Wessex	mm	77	321		759		898		1169	
	%	119	131	5-10	158	120-170	137	35-50	140	80-120
South West	mm	81	390		961		1136		1413	
	%	80	103	2-5	135	15-25	122	5-15	120	10-15
Welsh	mm	114	408		1066		1323		1628	
	%	118	104	2-5	135	20-30	127	15-25	124	20-30
Scotland	mm	**96**	**366**		**910**		**1143**		**1424**	
	%	**94**	**91**	**2-5**	**107**	**2-5**	**99**	**2-5**	**99**	**2-5**
Highland	mm	105	393		985		1222		1580	
	%	83	77	5-10	91	2-5	86	5-10	90	5-10
North East	mm	89	282		714		893		1171	
	%	138	110	2-5	132	30-40	117	5-10	120	15-25
Tay	mm	128	414		925		1153		1406	
	%	135	113	2-5	127	10-15	118	5-10	114	5-10
Forth	mm	91	311		752		989		1227	
	%	115	101	2-5	117	5-10	112	5-10	111	5-10
Tweed	mm	93	275		683		923		1156	
	%	139	106	2-5	127	10-20	121	10-15	119	10-20
Solway	mm	105	435		1127		1417		1678	
	%	104	107	2-5	133	20-35	124	10-20	118	5-15
Clyde	mm	101	455		1134		1415		1689	
	%	86	94	2-5	109	2-5	103	2-5	100	<2
Northern Ireland	mm	**62**	**262**		**706**		**900**		**1114**	
	%	**80**	**89**	**2-5**	**116**	**5-10**	**108**	**2-5**	**105**	**2-5**

RP = Return period

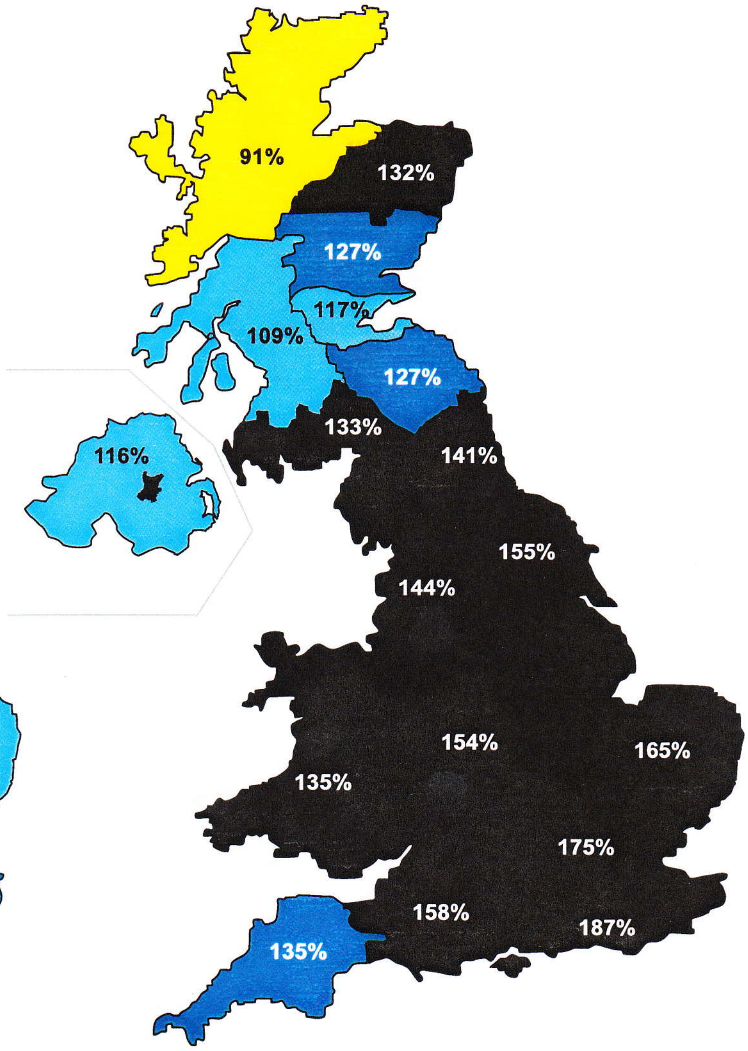
The monthly rainfall figures* are copyright of The Met. Office and may not be passed on to any unauthorised person or organisation. **All monthly totals since December 1998 are provisional (see page 12).** The return period estimates are based on tables provided by the Meteorological Office (see Tabony, 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





December 2000 - February 2001

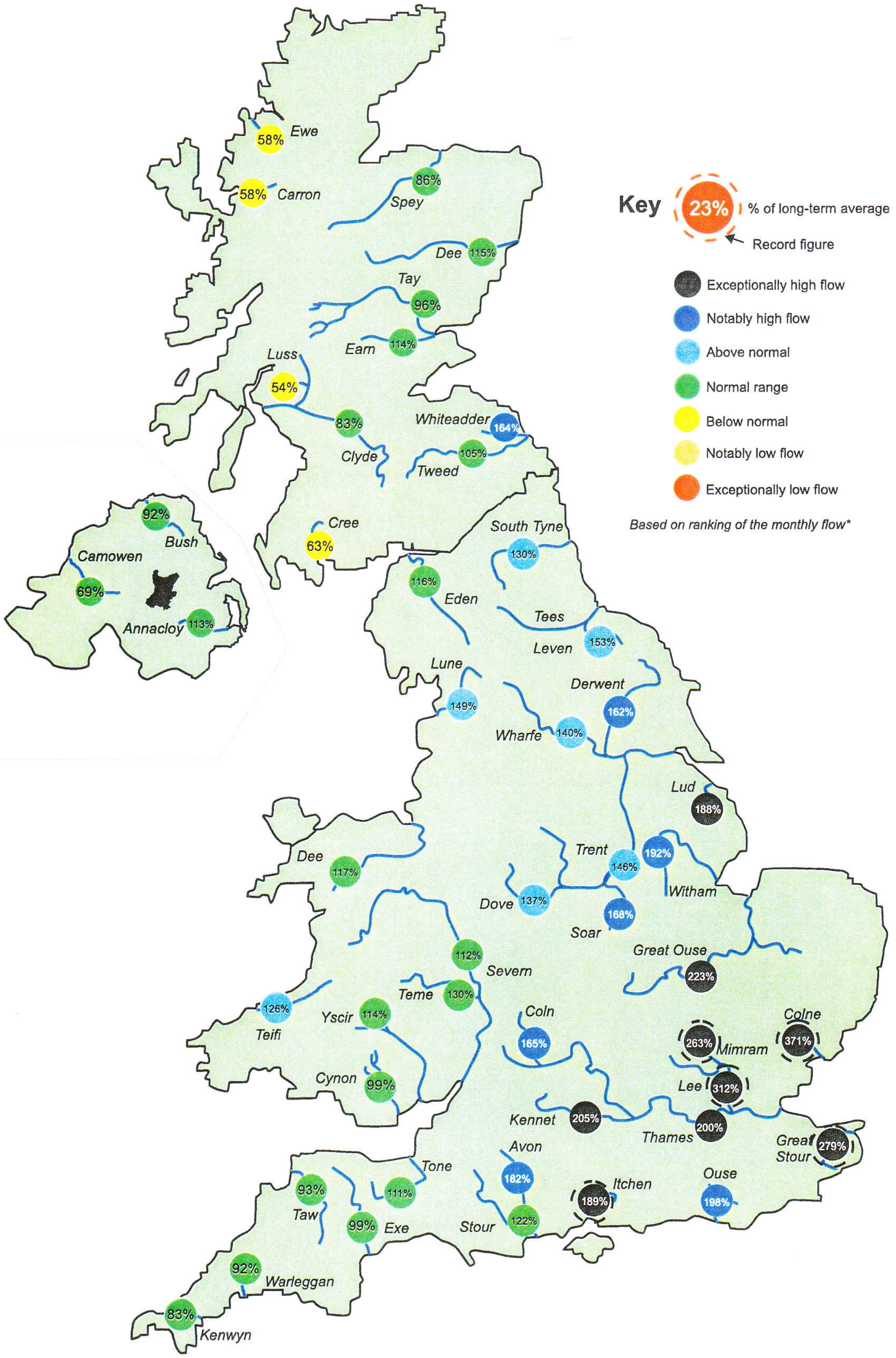


September 2000 - February 2001

Rainfall accumulation maps

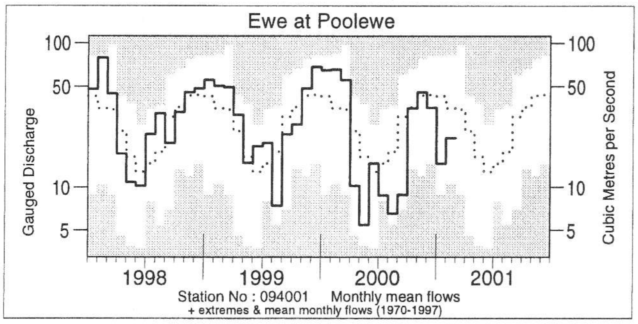
After three wet winters in succession, Northern Ireland and Scotland both recorded below average Dec-Feb rainfall totals; relative to the long term average the Highland Region was especially dry. A notable recent moderation in the normal north-west to south-east rainfall gradient across the country is evident the modest margin by which the Sept 2000-Feb 2001 rainfall for the Highland Region exceeds that for the EA Southern Region.

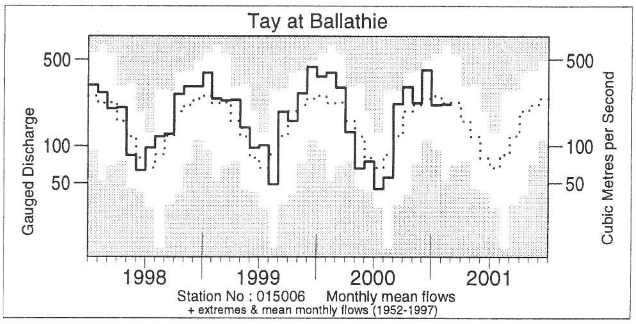
River flow . . . River flow . . .

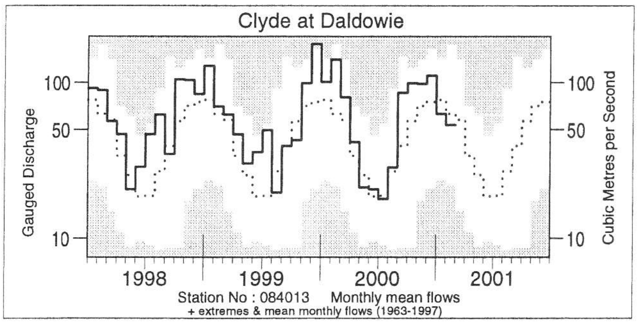


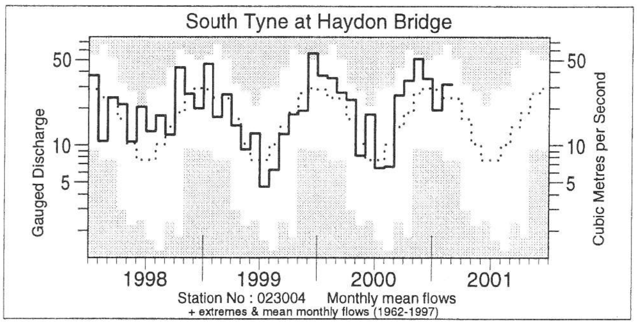
River flows - February 2001

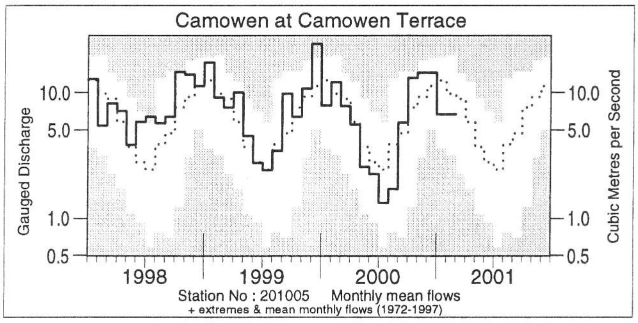
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

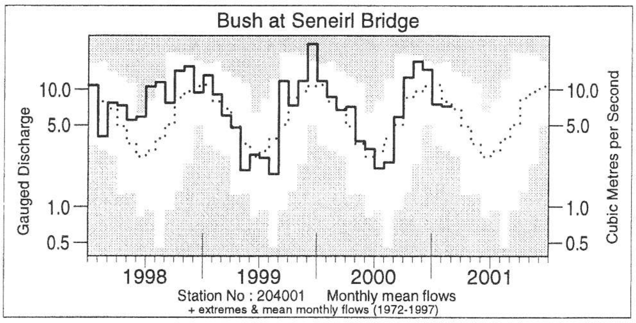


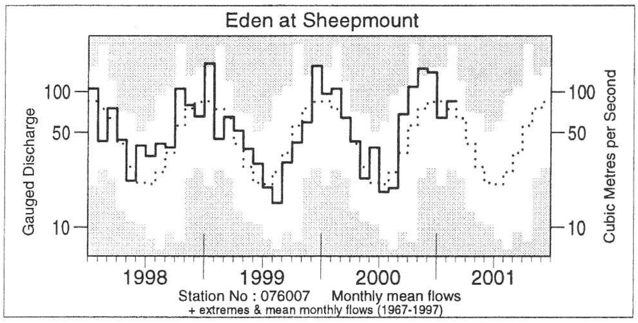


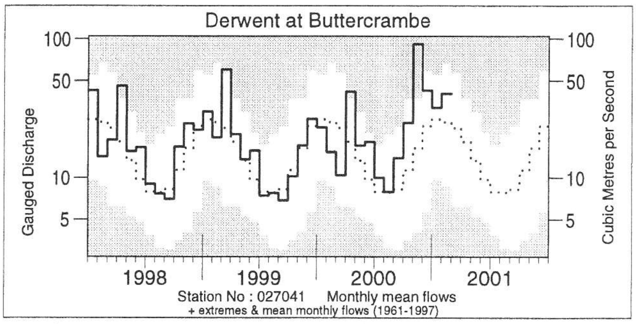


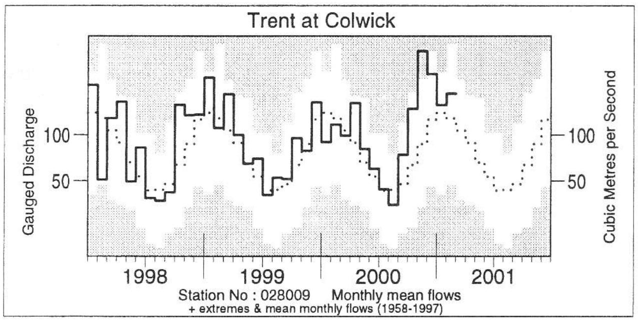


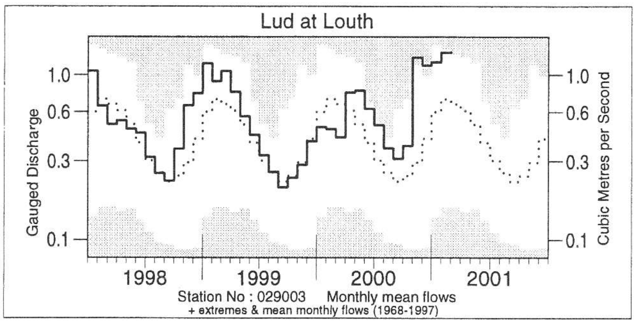








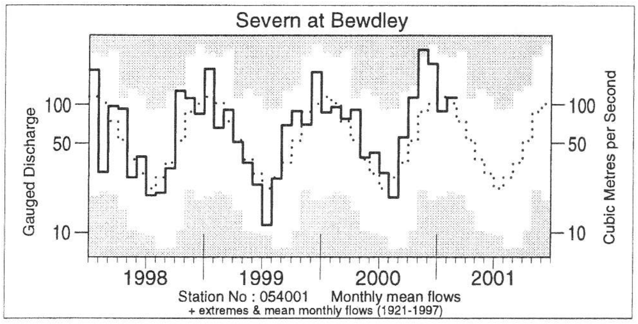


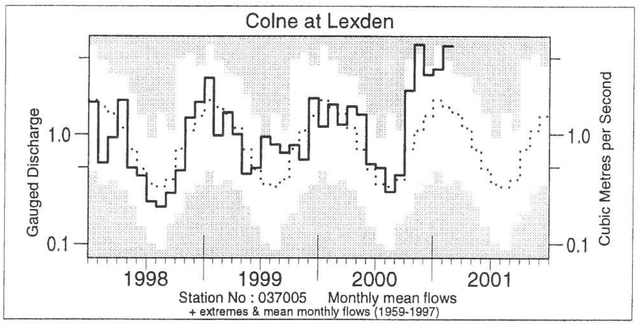


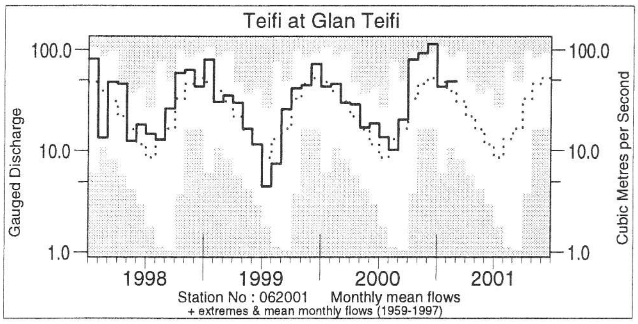
Monthly river flow hydrographs

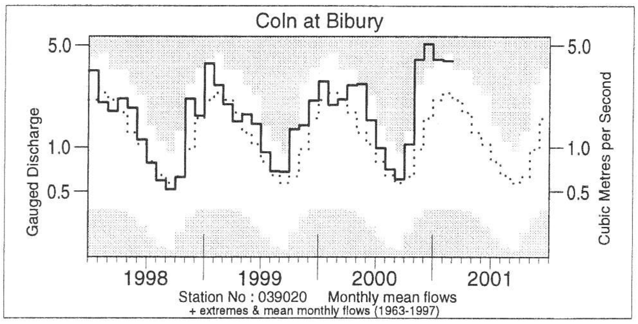
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1998 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

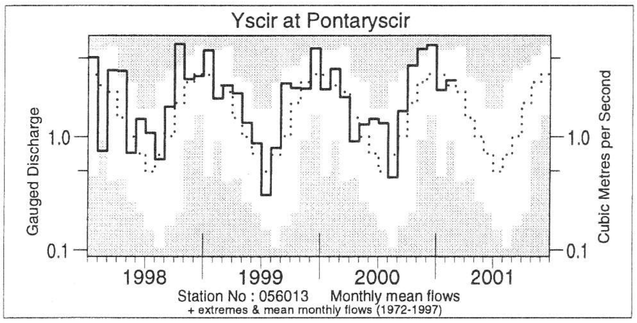
River flow . . . River flow . . .

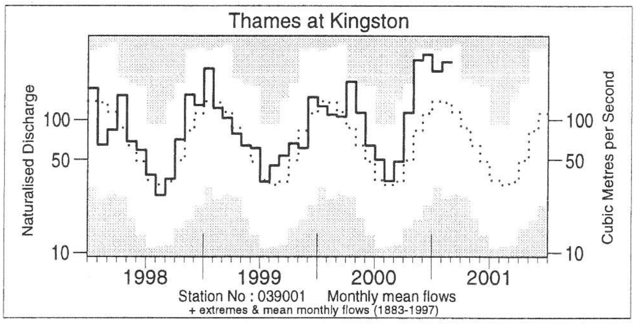


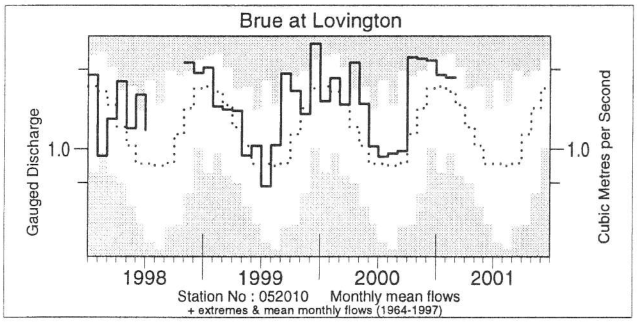


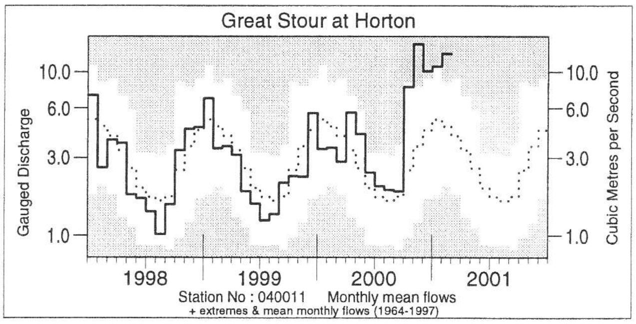


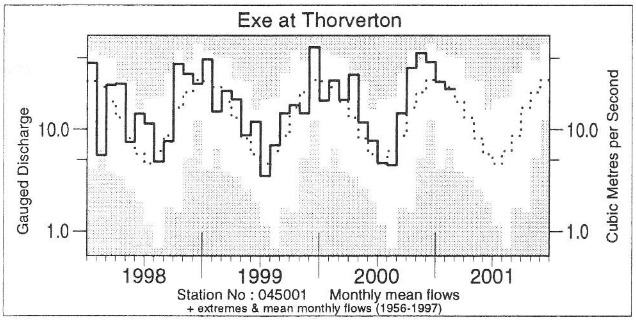


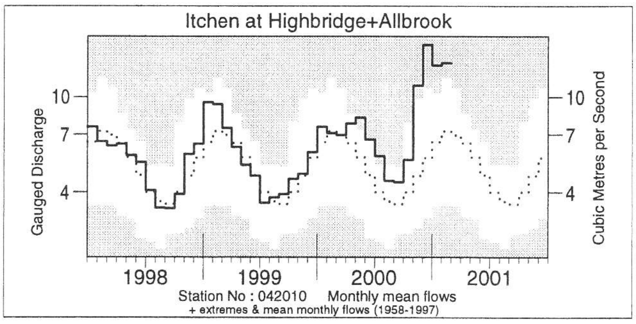










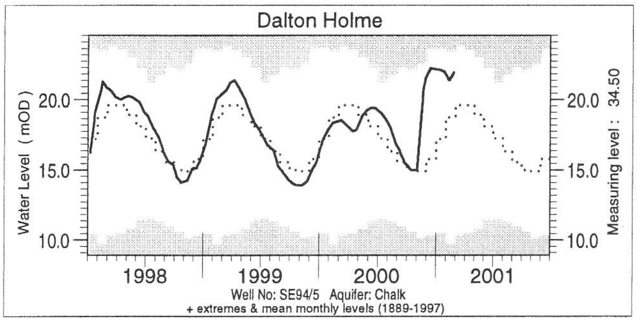


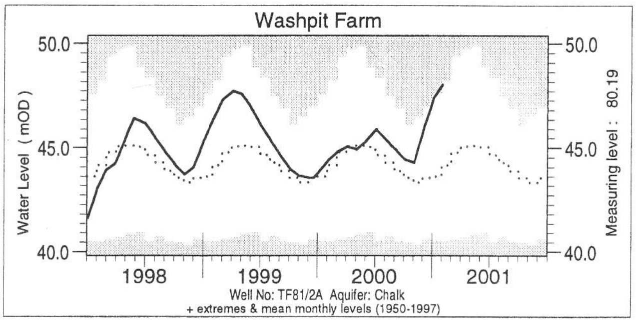
Notable runoff accumulations (a) December 2000 - February 2001, (b) September 2000 - February 2001

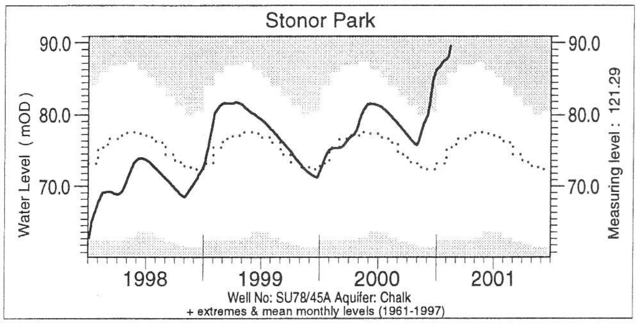
River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
(a) Ouse	213	68/68	Piddle	202	37/37	Lee	281	115/115
Lee	256	116/116	Carron	53	2/22	Thames	226	118/118
Thames	210	118/118	(b) Wharfe	164	45/45	Severn	170	80/80
Itchen	219	43/43	Trent	191	42/42	Dee	157	63/63

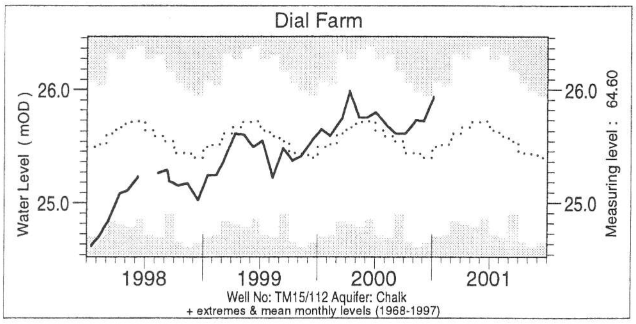
lta = long term average
Rank 1 = lowest on record

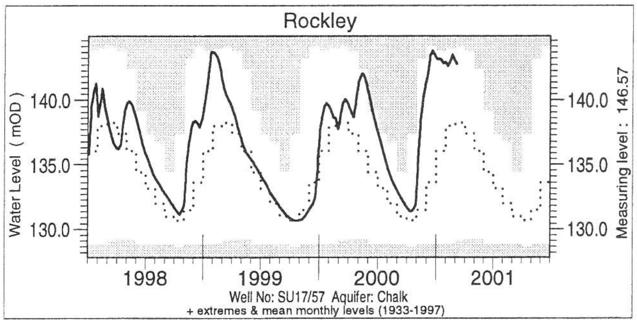
Groundwater . . . Groundwater

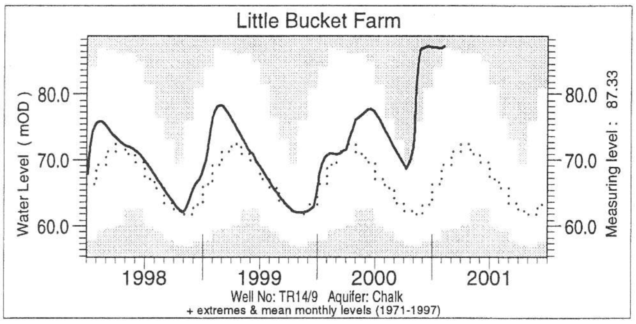


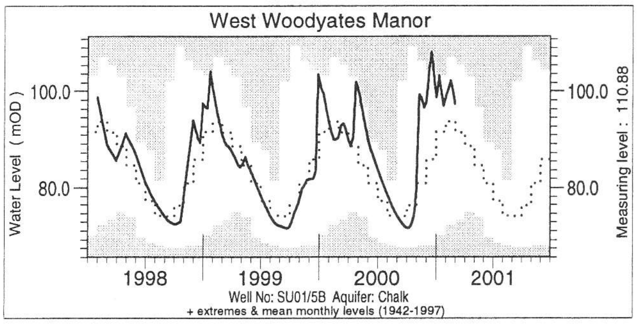


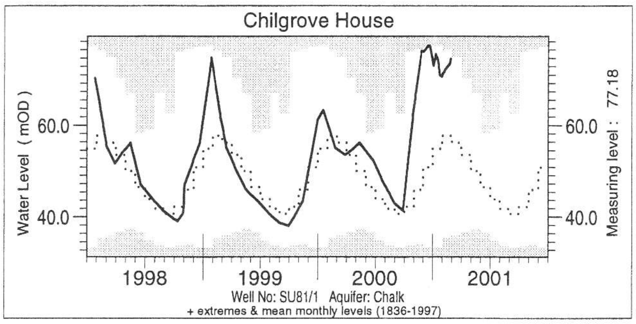


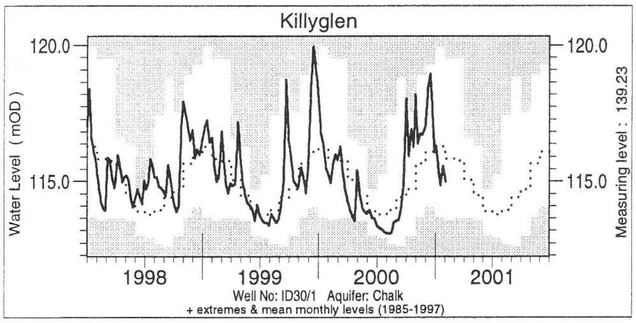


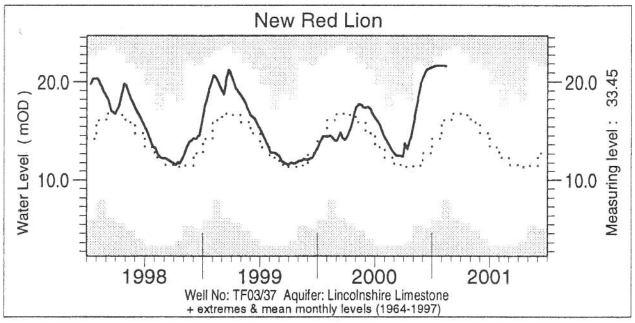








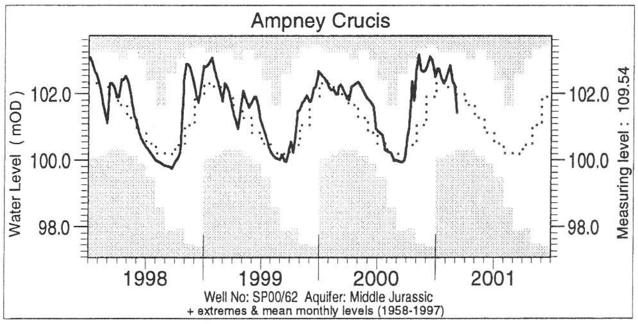


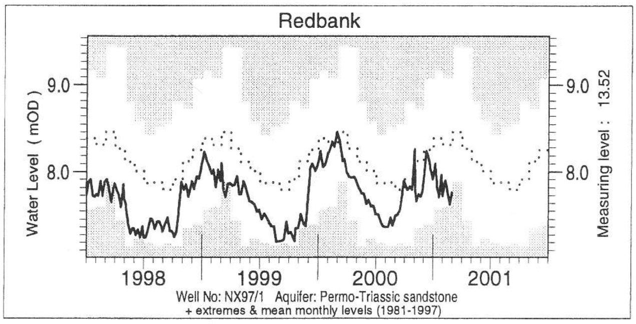


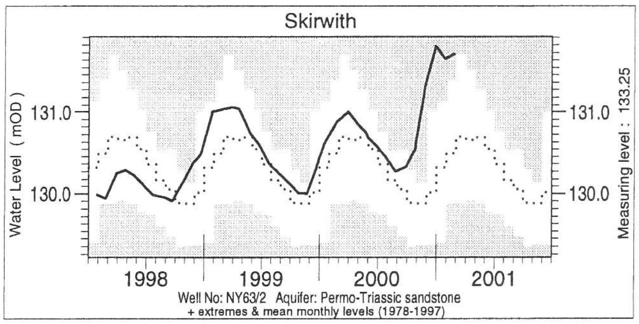
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

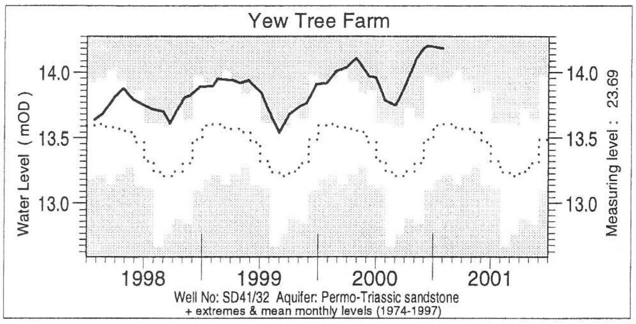
Note. Due to the impact of abstraction on groundwater levels at The Holt borehole, it has been replaced as an index site by the Stonor Park well.

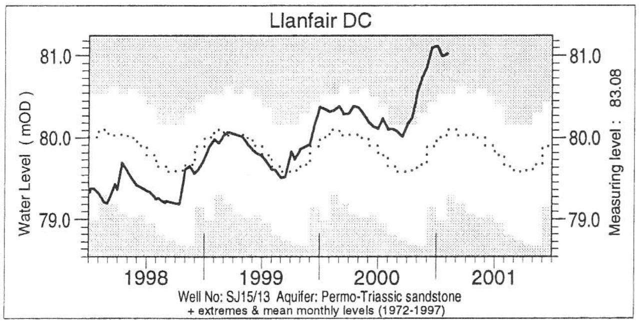
Groundwater . . . Groundwater

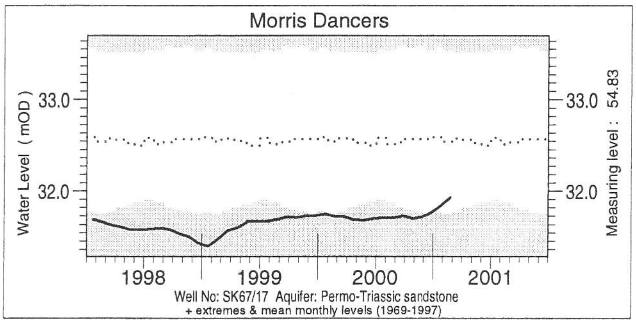


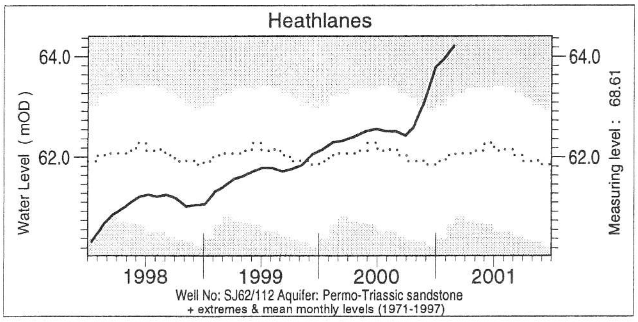


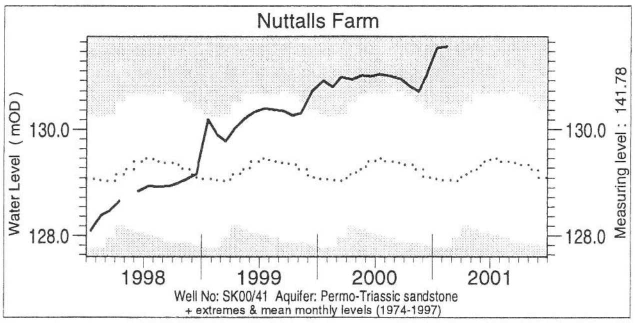


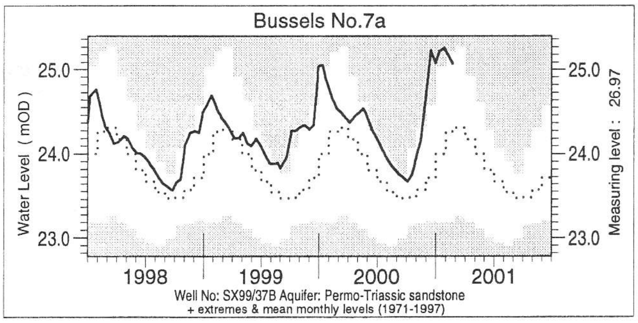


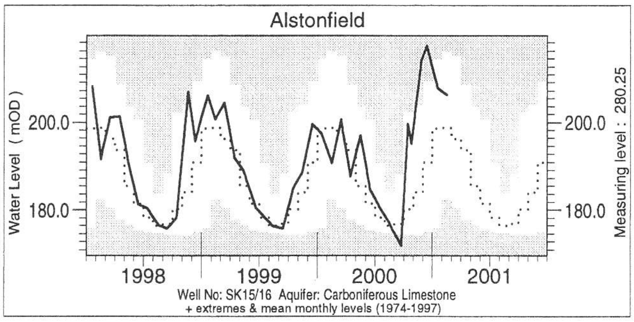








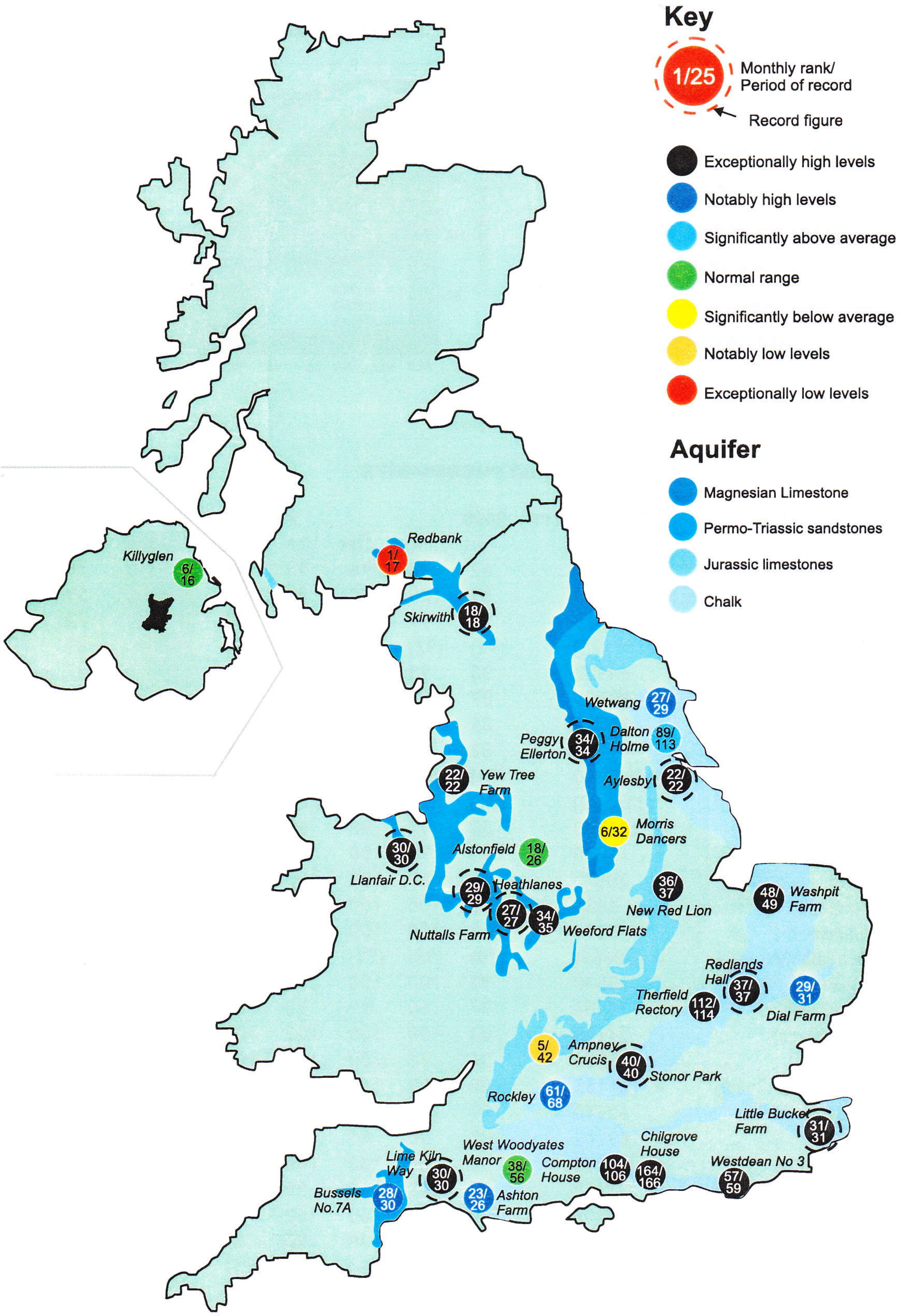




Groundwater levels February/March 2001

Borehole	Level	Date	Feb. av.
Dalton Holme	21.90	23/02	18.70
Washpit Farm	48.05	02/02	44.21
Therfield Rectory	93.37	05/03	78.05
Dial Farm	25.94	04/01	25.48
Rockley	142.76	05/03	138.20
Little Bucket	87.16	08/02	69.59
West Woodyates	97.34	28/02	93.04
Chilgrove	74.45	25/02	57.46
Killyglen	114.99	01/02	115.70
New Red Lion	21.61	13/02	16.10
Ampney Crucis	101.43	05/03	102.22
Redbank	7.76	28/02	8.36
Skirwith	131.71	23/02	130.54
Yew Tree Farm	14.18	30/01	13.63
Llanfair D.C.	81.02	01/02	79.97
Morris Dancers	31.93	23/02	32.40
Heathlanes	64.21	23/02	61.89
Nuttalls Farm	131.55	14/02	129.25
Bussels No. 7A	25.07	20/02	24.30
Alstonfield	206.36	15/02	198.34

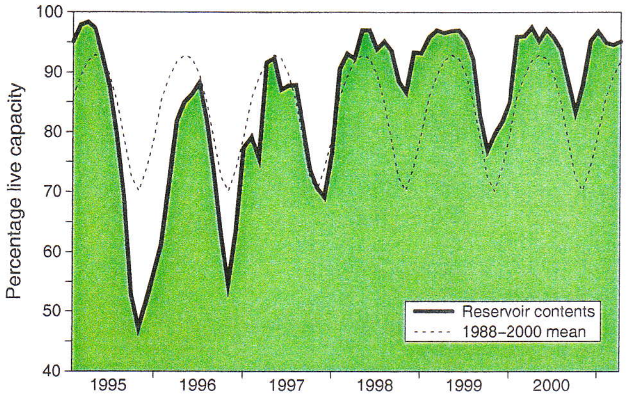
Levels in metres above Ordnance Datum



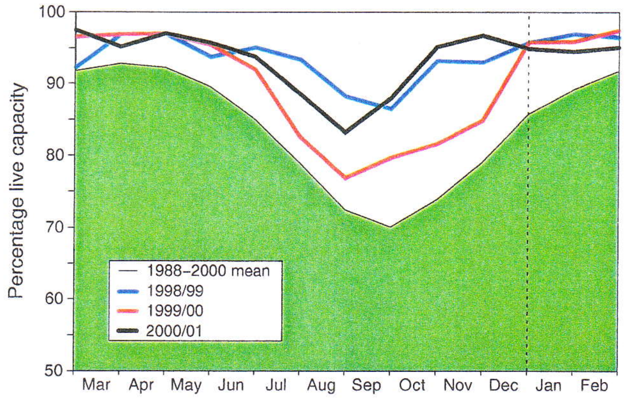
Groundwater levels - February 2001

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.

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.

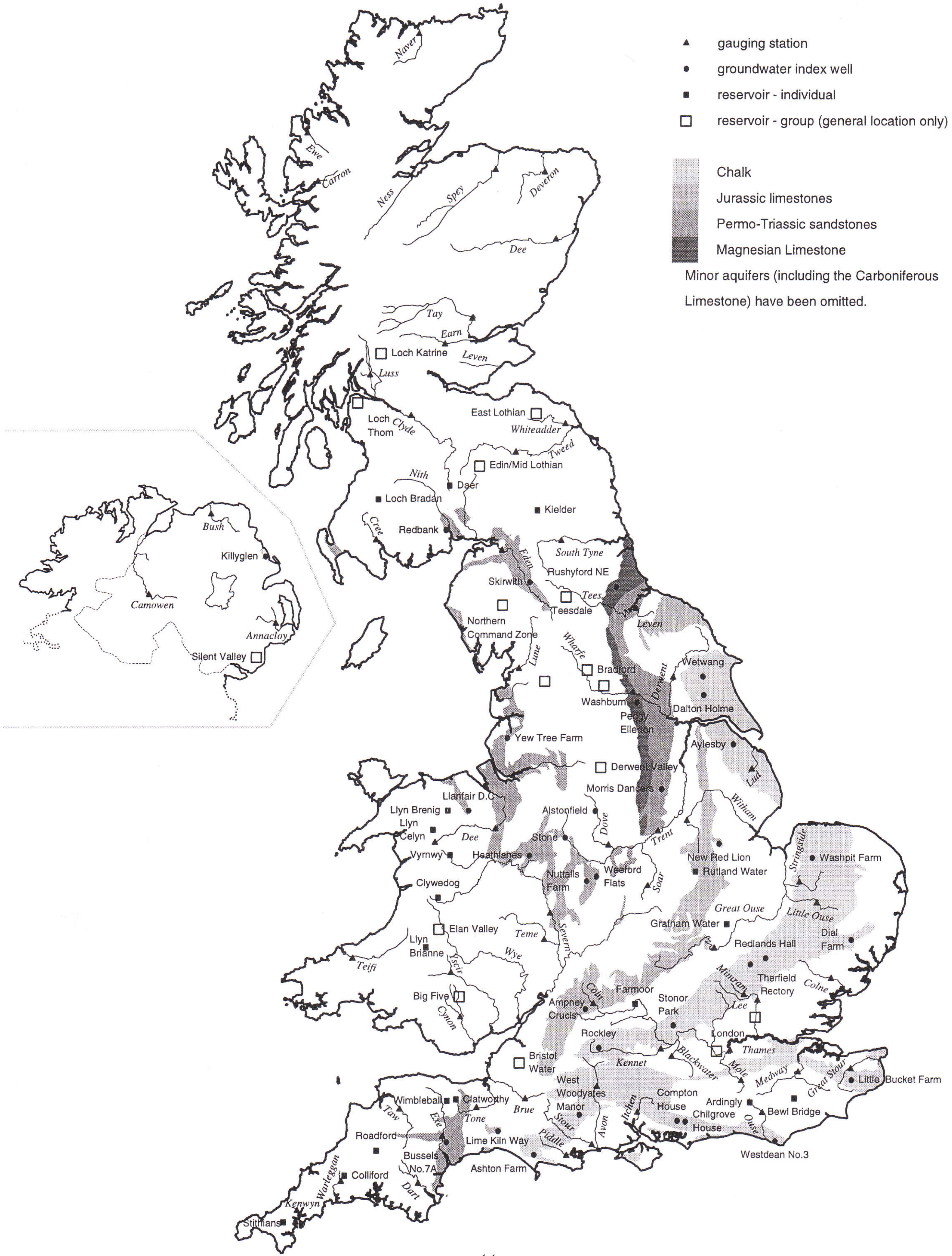
Percentage live capacity of selected reservoirs

Area	Reservoir	Capacity (Ml)	2000 Oct	Nov	Dec	2001 Jan	Feb	Mar	Min. Mar	Year* of min
North West	N Command Zone	• 124929	62	78	96	95	94	94	78	1996
	Vyrnwy	55146	99	100	100	93	93	98	59	1996
Northumbrian	Teesdale	• 87936	95	99	100	99	97	91	72	1996
	Kielder	(199175)	(93)	(97)	(95)	(93)	(91)	(92)	81	1993
Severn Trent	Clywedog	44922	90	98	98	82	82	91	77	1996
	Derwent Valley	• 39525	87	100	100	100	94	98	46	1996
Yorkshire	Washburn	• 22035	85	98	97	89	95	97	53	1996
	Bradford supply	• 41407	83	99	100	99	99	97	53	1996
Anglian	Grafham	** (55490)	(94)	(94)	(89)	(88)	(88)	(88)	72	1997
	Rutland	**(116580)	(81)	(89)	(89)	(89)	(86)	(92)	71	1992
Thames	London	• 202340	88	97	98	98	97	96	83	1988
	Farmoor	• 13830	95	90	90	80	72	81	64	1991
Southern	Bewl	28170	80	89	98	100	100	100	50	1989
	Ardingly	4685	83	100	100	100	100	100	89	1992
Wessex	Clatworthy	5364	63	100	100	100	97	100	82	1992
	Bristol WW	• (38666)	(76)	(95)	(99)	(95)	(100)	(98)	65	1992
South West	Colliford	28540	92	100	100	100	100	100	57	1997
	Roadford	34500	97	100	99	98	98	97	35	1996
	Wimbleball	21320	83	100	100	100	100	100	72	1996
	Stithians	5205	56	76	100	100	100	100	45	1992
Welsh	Celyn and Brenig	• 131155	98	99	100	95	97	99	69	1996
	Brianne	62140	97	100	100	94	97	95	94	1998
	Big Five	• 69762	83	90	89	94	100	97	85	1988
	Elan Valley	• 99106	96	100	100	100	99	98	88	1993
East of Scotland	Edinburgh/Mid Lothian	• 97639	91	99	100	99	99	99	73	1999
	East Lothian	• 10206	100	100	100	100	100	100	91	1990
West of Scotland	Loch Katrine	• 111363	75	97	98	90	94	95	93	1999
	Daer	22412	98	100	100	100	100	100		
	Loch Thom	• 11840	80	100	100	100	100	98	98	1996
Northern Ireland	Silent Valley	• 20634	45	65	85	100	95	96	63	2000

() 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 1988-2000 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 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 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 CEH Wallingford) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Rainfall

Most rainfall data are provided by The Met. Office (address opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of The Met. Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS*. Recent figures have been produced by The Met. Office, National Climate Information Centre (NCIC), using a technique similar to CARP. An initiative is underway with The Met. Office to provide more accurate areal figures and, since October 1999, to include more raingauges in the analysis. A significant number of additional monthly rainfall totals are currently being provided by the Environment Agencies; over the coming months further monthly raingauge totals will be included for selected regions. Until the access to these additional data has stabilised the regional figures (and the return periods associated with them) should be regarded as a guide only.

*MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

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The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged; the Hydrological Summaries for the autumn and early winter of 2000/2001, in particular, stand as a testimony to the assistance provided by many hydrometric personnel working in exceptionally challenging circumstances.

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.nwl.ac.uk/ih

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