Hydrological summary

for the United Kingdom

June 2001

General

June was a relatively dry month over most of the UK, with particularly modest rainfall totals across southern England. The limited rainfall and high evaporation rates since late-April – with the consequent rapid drying of lowland soils - has produced a dramatic transformation in the landscape. River flows continued to decline steeply in June and were depressed in a few impermeable southern catchments at month-end. With limited recent replenishment and increasing water demand (e.g. for spray irrigation), overall reservoir stocks have decreased by around 12% over the last two months – apart from 1995, this represents the most rapid May/June decline over the last decade. Nonetheless, overall stocks for England and Wales remain marginally above the early July average, and groundwater levels in June generally exceeded the early summer average by a wide margin. As is often the case following a wet winter, the recent dry spell has emphasised the contribution of groundwater both to the security of water resources and to the maintenance of summer flows in spring-fed rivers.

Rainfall

Weather conditions varied greatly through June – with occasional overnight frosts and heat-wave conditions at month-end. Most rain-bearing frontal systems followed northerly tracks resulting in lengthy dry spells in southern Britain. Some central and southern districts reported 23-25 days without significant rainfall, but the 14-17th was a very unsettled interlude. Thunderstorms produced 51 mm in three hours at Leeming on the 15th and damaging hailstorms (e.g in Luton); the following day there were more downpours of tropical intensity (including 35 mm in an hour at Bablake in the Midlands) as convective activity became more widespread. Correspondingly, spatial variations in rainfall totals were large but regional totals were well below the June average across much of England and Wales. Southern coastal areas were especially dry; Havant (Hants) registered only a quarter of the June average rainfall. Rainfall in Northern Ireland was close to the 1961-90 average, as it was across most of Scotland - in a few western catchments June recorded the first above average rainfall in six or more months. Provisional rainfall figures suggest that England and Wales experienced its second driest May/June period (after 1995) in the last 25 years; a few southern catchments were drier than in the 1976 drought. The recent dry spell reinforces the remarkable partitioning of rainfall over the last 12 months; around 70% of the total rainfall in much of the South-East fell in the winter half-year (Oct-Mar), a proportion much more typical of north-western Spain (as is the 12-month total).

River Flow

In the great majority of catchments, June was a month of sustained recessions interrupted by short-lived and modest spates – often associated with thunderstorms which brought flooding to a number of urban areas (e.g. Norwich and High Wycombe on the 16/17th). The range of mean flows (as a % of the long term average) in June was exceptionally wide – a testimony more to the influence of catchment geology than differing rainfall patterns. Steep recessions resulted in well below average late-June flows in rivers draining impermeable catchments – triggering flow augmentation measures in a few southern rivers (e.g. the Sussex Ouse). By contrast, exceptional groundwater contributions continued to sustain notable discharge rates in many spring-fed streams; the Mimram and Itchen both established new June maximum runoff totals. In parts of the South particularly (e.g. Hampshire and Sussex) very healthy flows in Chalk streams were juxtaposed with depressed flow rates in neighbouring impermeable catchments. Over the year thus far, some rivers in Scotland (e.g. the Luss and Spey) and Northern Ireland (e.g. the Bush) have established new minimum Jan-June flows, whilst corresponding flows in many English lowland rivers exceed the previous maxima. As usual, winterbournes will fail and the stream network shrink through the summer but, in the event of continuing limited rainfall, the hydrological impact will be felt most keenly in streams draining impermeable catchments.

Groundwater

A second successive month of low rainfall and exceptionally high evaporation losses resulted in above average soil moisture deficits throughout all major outcrop areas by late-June. Deficits in a few parts of southern England approached the late June maxima registered in 1995 and 1976. Correspondingly, infiltration was restricted to very localised events – mostly associated with thunderstorms. After extending the range of recorded maxima throughout the winter and spring, groundwater levels in almost all aquifer units are in brisk decline. Current levels reflect both the winter rainfall and the responsiveness of individual aquifer units (which can vary greatly, due to, for example, the density of fissures, depth to the water-table and the depth of superficial deposits). In the western Chalk, and in most limestone aquifers (parts of the Magnesian Limestone excepted), levels have fallen to within the normal early summer range. In the eastern Chalk (including the Chilterns), most levels remain exceptionally high – unprecedented for June in a few cases (e.g. Stonor). Continuing Foot and Mouth restrictions allow only speculative generalisations regarding the Permo-Triassic sandstones but levels in most index wells are close to seasonal maxima, and in some cases still above pre-2001 maxima (e.g. at Heathlanes and Yew Tree Farm). Overall groundwater resources are very healthy for the summer.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall accumulations and return period estimates

Area	Rainfall	Jun 2001	Apr 01-Jun 01	RP	Jan 01-Jun 01	RP	Oct 00-Jun 01	RP	Jul 00-Jun 01	RP
England & Wales	mm	**42**	**185**		**477**		**984**		**1247**	
	%	**65**	**97**	**2-5**	**113**	**2-5**	**141**	**150-250**	**137**	**150-250**
North West	mm	56	224		467		1109		1464	
	%	69	99	2-5	90	2-5	124	10-20	122	10-20
Northumbrian	mm	64	161		360		747		986	
	%	106	90	2-5	92	2-5	118	5-10	116	5-10
Severn Trent	mm	34	187		374		761		983	
	%	57	108	2-5	104	2-5	133	30-50	130	35-50
Yorkshire	mm	49	176		364		779		1027	
	%	82	98	2-5	95	2-5	126	10-20	125	20-30
Anglian	mm	37	153		350		639		820	
	%	72	106	2-5	125	5-15	144	110-150	138	110-150
Thames	mm	30	150		400		791		979	
	%	55	93	2-5	123	5-10	151	150-250	142	120-170
Southern	mm	21	120		448		972		1176	
	%	38	75	2-5	125	5-10	161	>>200	151	>>200
Wessex	mm	27	139		425		905		1127	
	%	47	81	2-5	108	2-5	140	40-60	134	40-60
South West	mm	40	174		520		1137		1417	
	%	58	83	2-5	95	2-5	123	5-15	121	10-15
Welsh	mm	43	237		559		1263		1610	
	%	55	98	2-5	95	2-5	124	10-20	123	10-20
Scotland	mm	**85**	**200**		**459**		**1037**		**1344**	
	%	**99**	**80**	**5-10**	**73**	**25-40**	**96**	**2-5**	**93**	**2-5**
Highland	mm	107	251		524		1200		1462	
	%	109	89	2-5	69	35-50	88	5-10	83	10-20
North East	mm	54	138		380		825		1071	
	%	82	71	5-15	87	5-10	114	5-10	110	2-5
Tay	mm	66	159		475		1006		1332	
	%	90	73	5-10	84	5-10	107	2-5	108	2-5
Forth	mm	70	162		402		829		1155	
	%	101	80	2-5	82	5-10	100	<2	104	2-5
Tweed	mm	74	170		387		787		1100	
	%	114	88	2-5	88	2-5	109	2-5	113	5-10
Solway	mm	77	214		491		1211		1627	
	%	92	87	2-5	79	5-10	113	5-10	115	5-10
Clyde	mm	105	232		538		1225		1644	
	%	113	87	2-5	74	10-20	96	2-5	97	2-5
Northern Ireland	mm	**63**	**179**		**361**		**826**		**1084**	
	%	**89**	**87**	**2-5**	**75**	**10-15**	**103**	**2-5**	**102**	**2-5**

RP = Return period

The monthly rainfall figures* are copyright of The Met. Office and may not be passed on to, or published by, any unauthorised person or organisation.
All monthly totals since December 1998 are provisional (see page 12). The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used to derive the CRU data series. The return period estimates are based on tables provided by the Meteorological Office (see Tabony, R.C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37) and relate to the specified span of months only (return periods may be up to an order of magnitude less if n-month periods beginning in any month are considered); RP estimates for Northern Ireland are based on the tables for north-west England. The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts, in the Scottish rainfall series in particular, can exaggerate the relative wetness of the recent past. * See page 12.

Rainfall . . . Rainfall . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

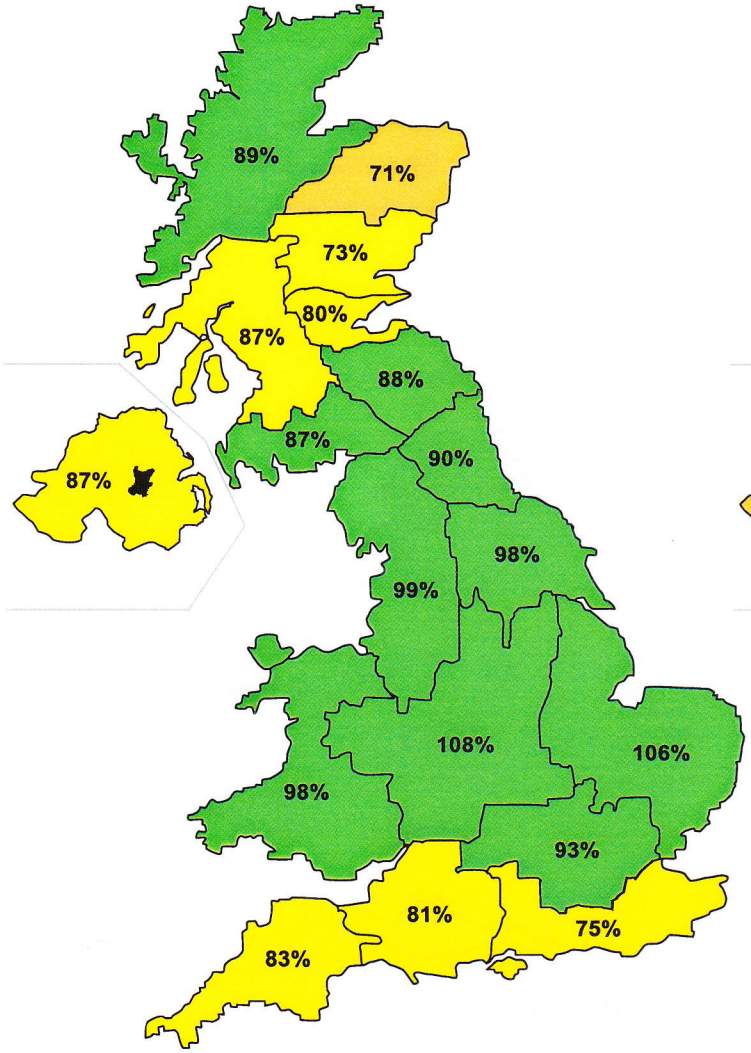
Above average

Normal range

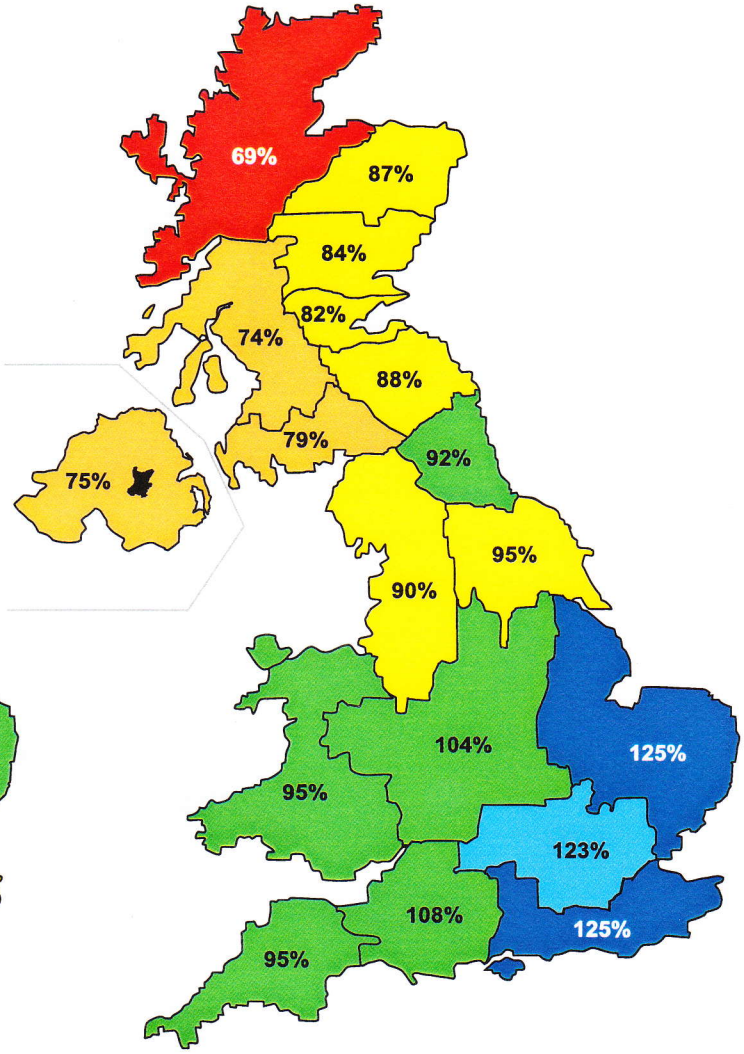
Below average

Substantially below average

Exceptionally low rainfall



April 2001 - June 2001

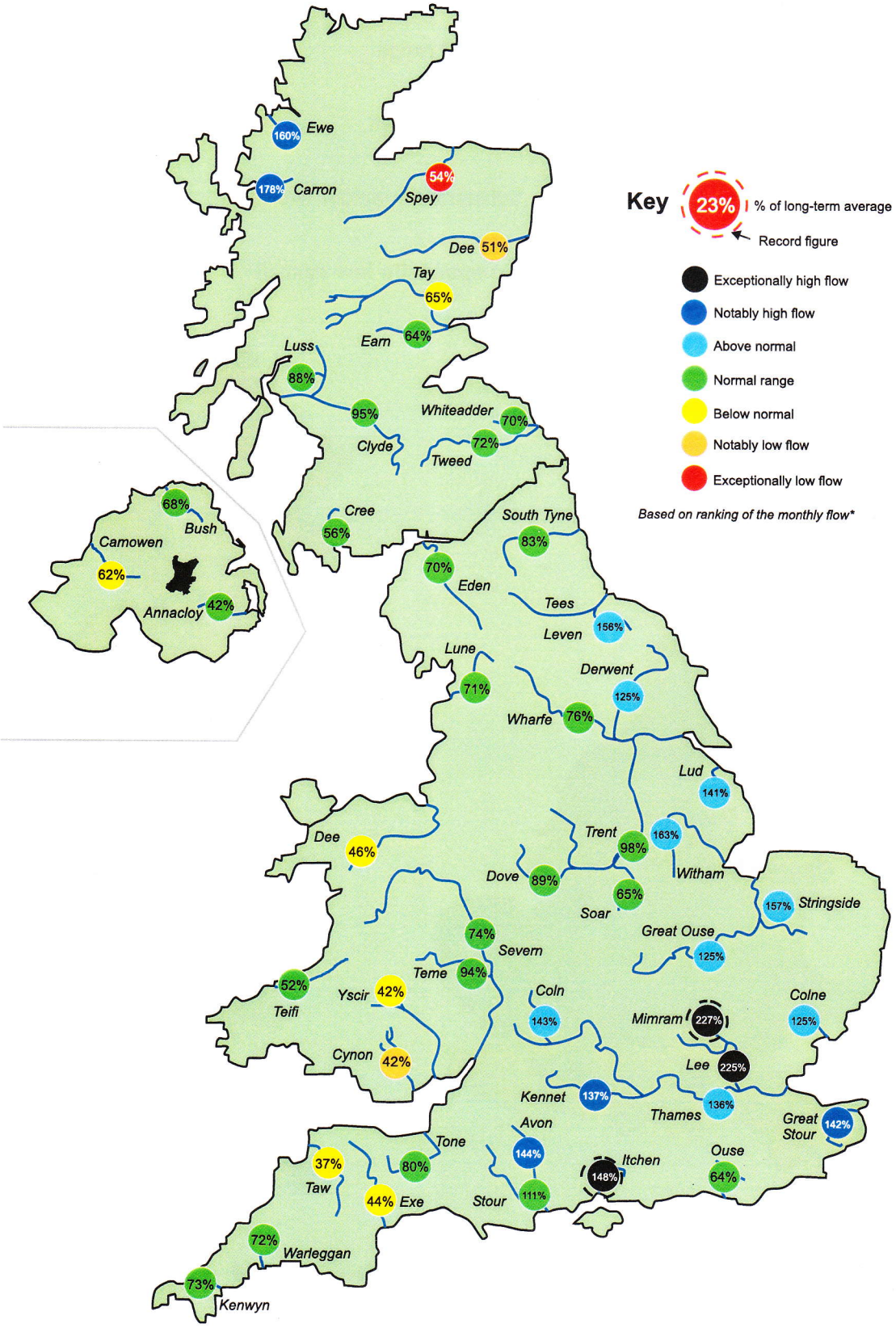


January 2001 - June 2001

Rainfall accumulation maps

Over the last three months rainfall has been modestly below average throughout most of the UK – but more so in many catchments draining to the English Channel, and in eastern Scotland where some districts had lower April-June rainfall than in the 1984 drought. For 2001 thus far, rainfall has been a little above average for England and Wales, but the Jan-June periods in the Scotland and Northern Ireland have (provisionally) been the driest since 1955 and 1959 respectively.

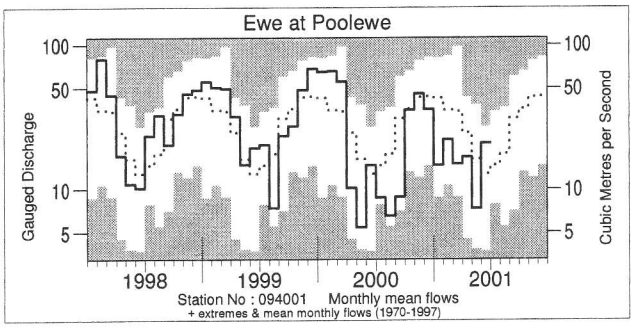
River flow . . . River flow . . .

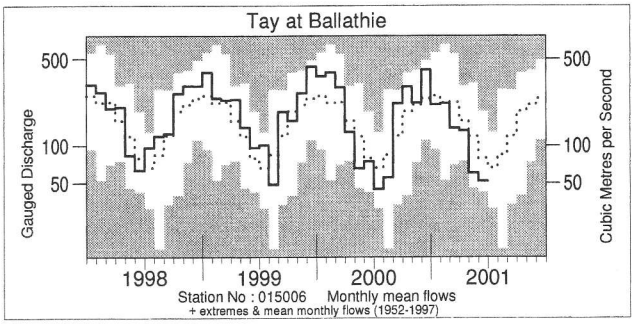


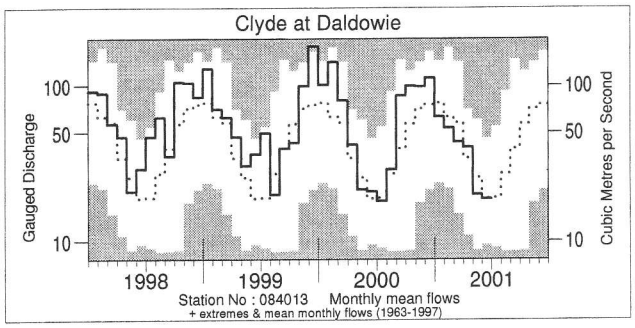
River flows - June 2001

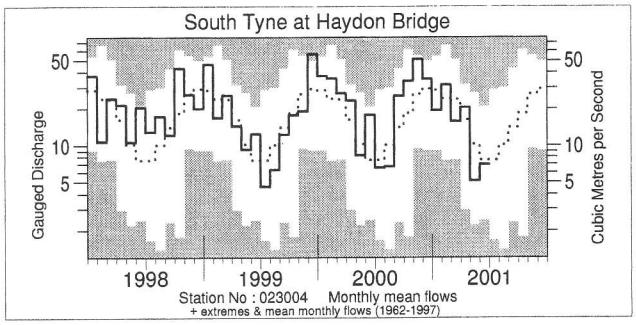
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

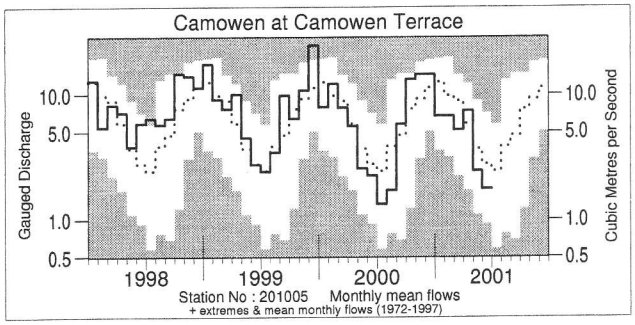
River flow . . . River flow . . .

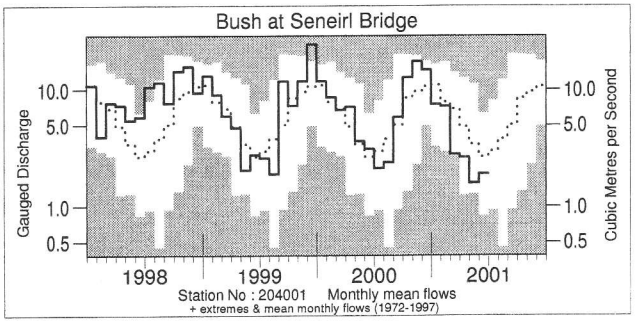


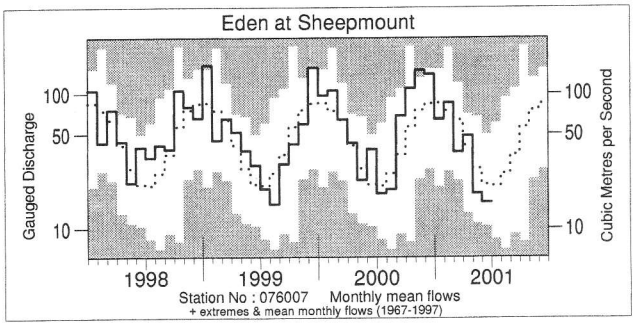


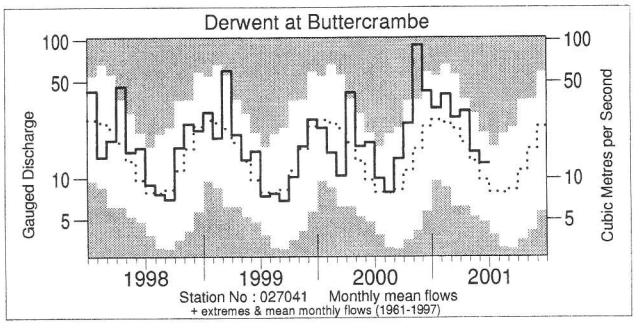


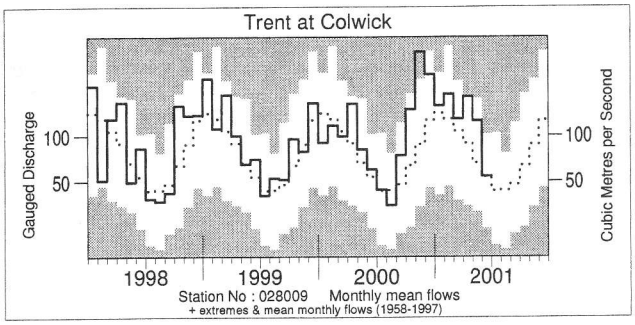


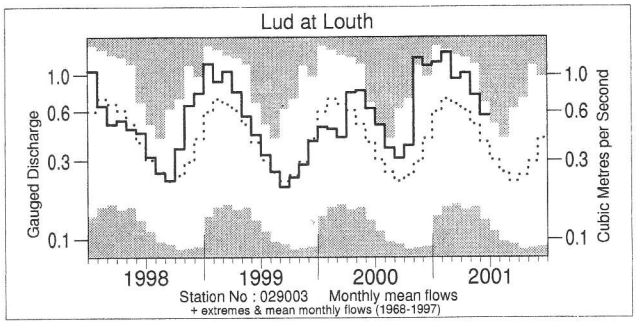








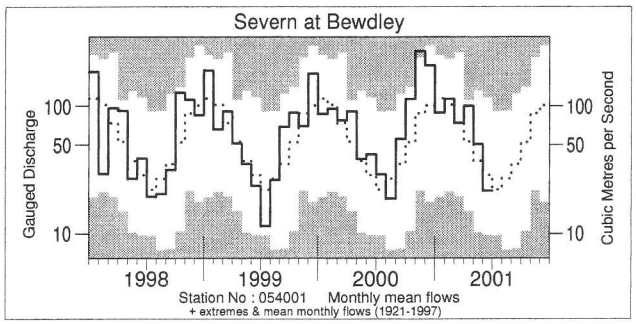


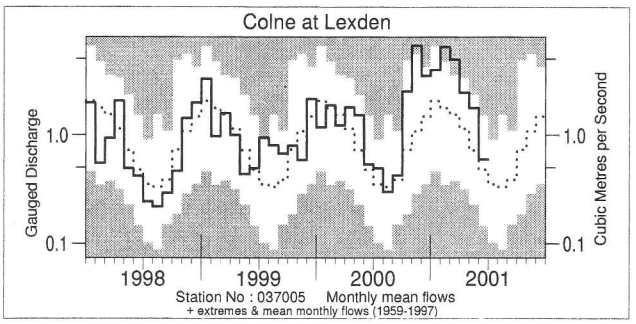


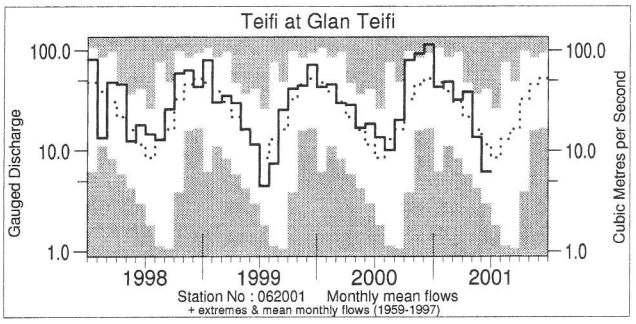
Monthly river flow hydrographs

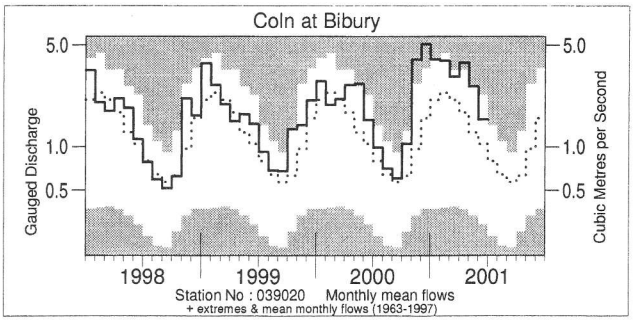
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1998 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded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

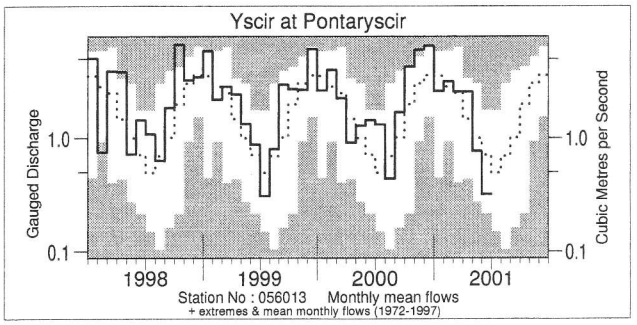
River flow . . . River flow . . .

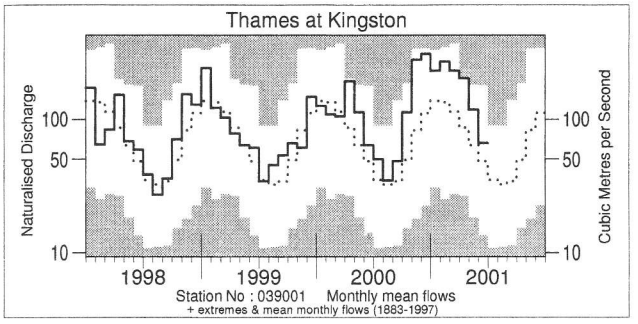


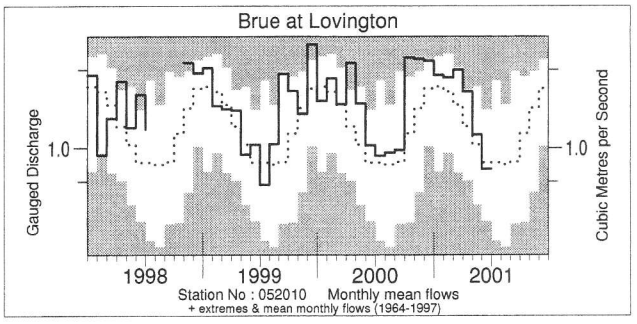


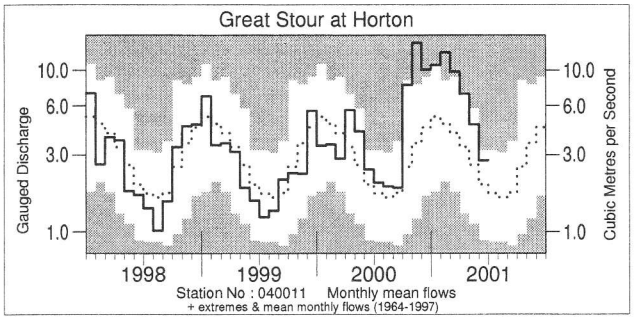


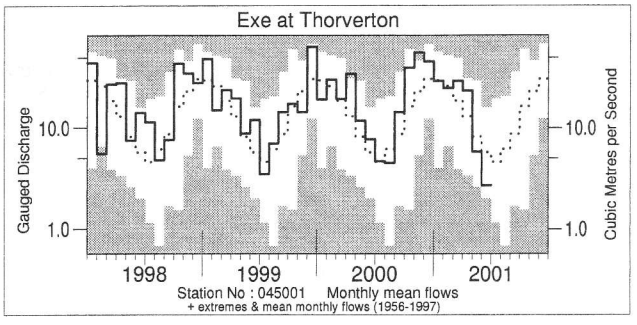


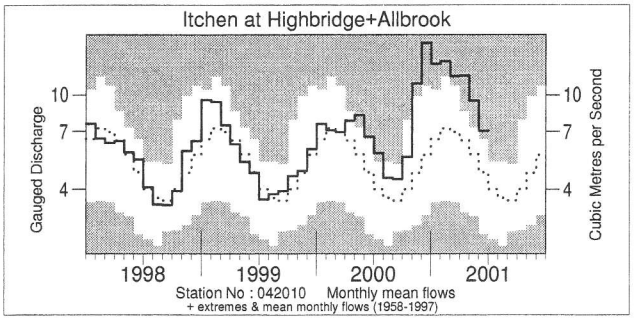










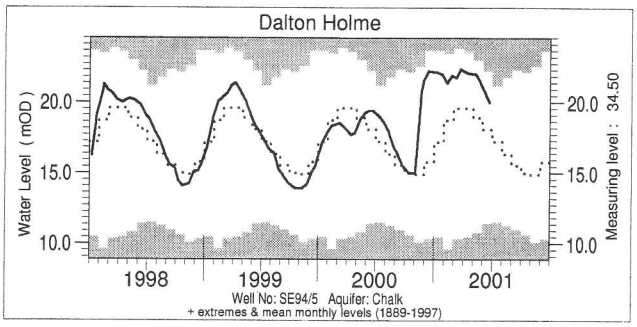


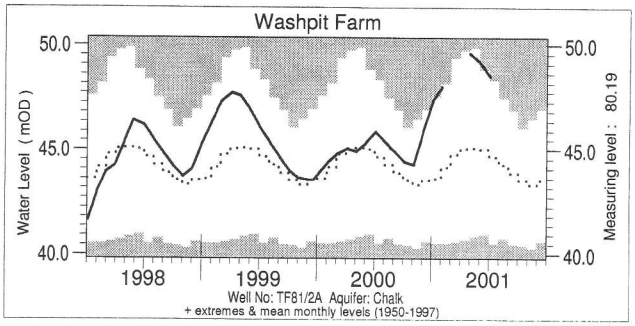
Notable runoff accumulations (a) April 2001 - June 2001, (b) January 2001 - June 2001

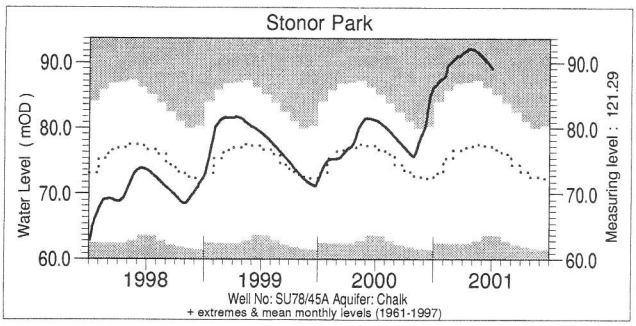
	River	%lta	Rank		River	%lta	Rank	River	%lta	Rank
(a)	Mimram	252	49/49	(b)	Stringside	182	35/35	Luss	61	1/23
	Kennet	169	40/40		Blackwater	201	49/49	Naver	62	1/24
	Itchen	166	43/43		Wallington	205	49/49	Spey(Boat of Garten)	62	1/50
	Avon (Hants)	174	37/37		Otter	138	39/39	Bush	64	1/29

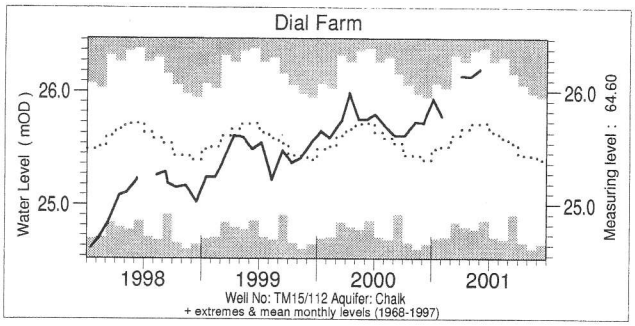
lta = long term average
Rank 1 = lowest on record

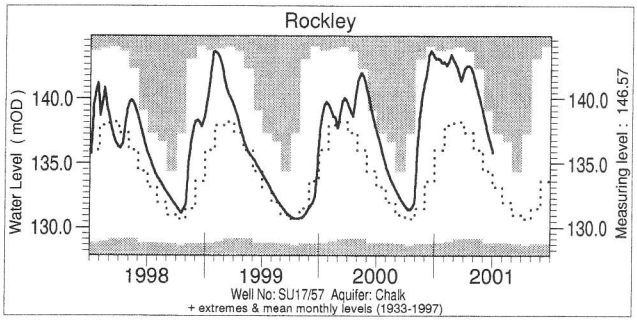
Groundwater . . . Groundwater

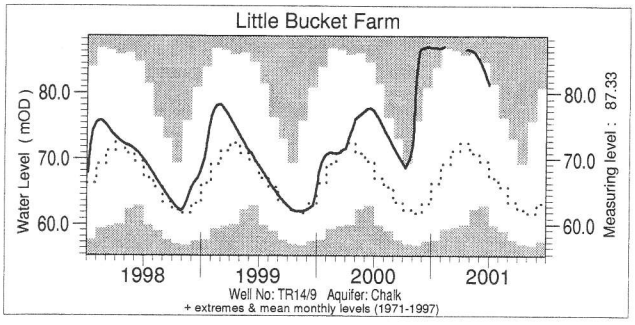


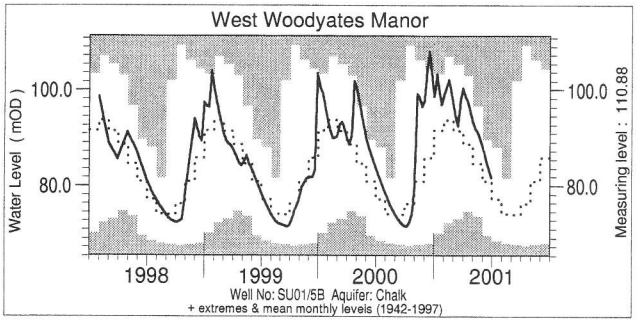


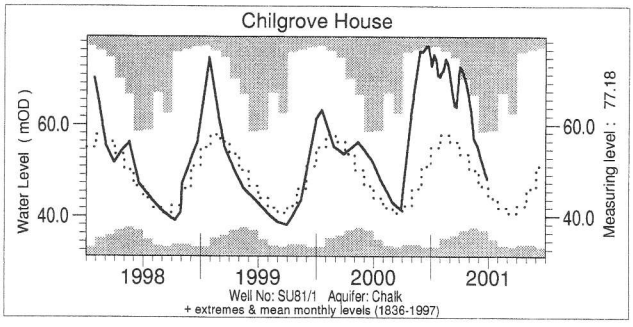


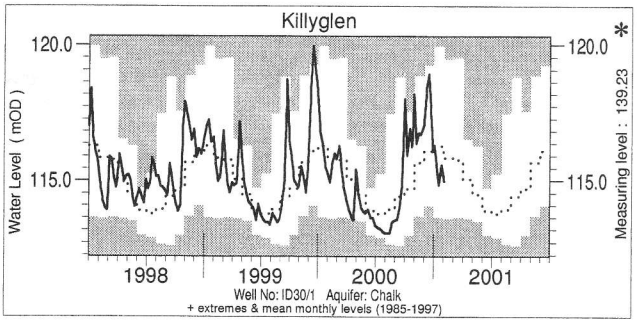


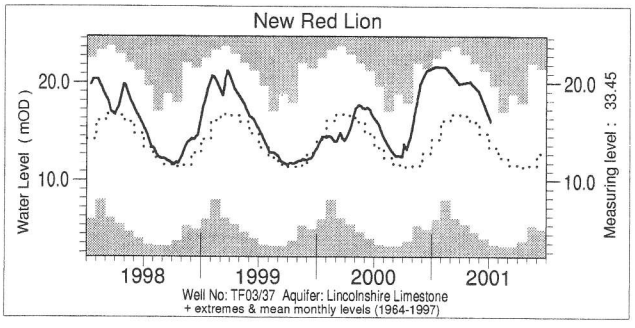








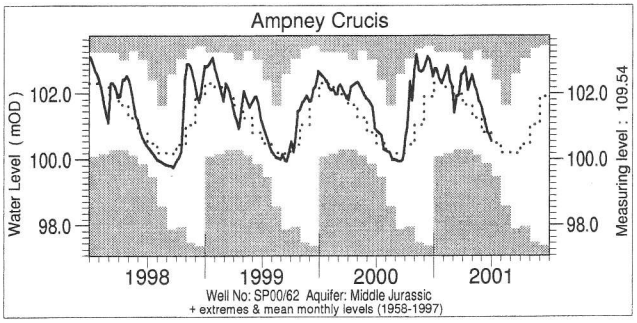


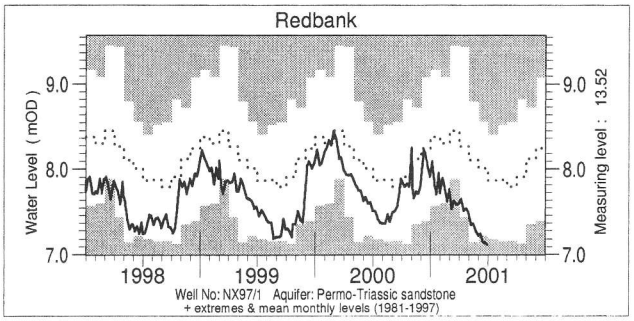


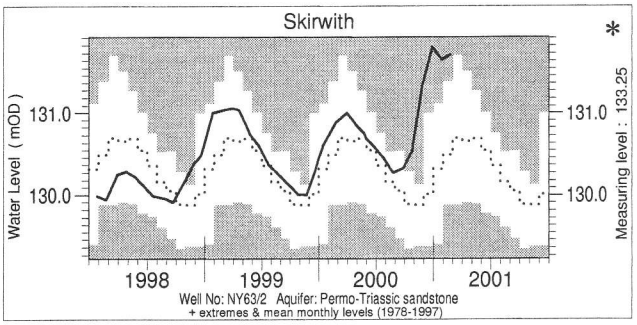
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

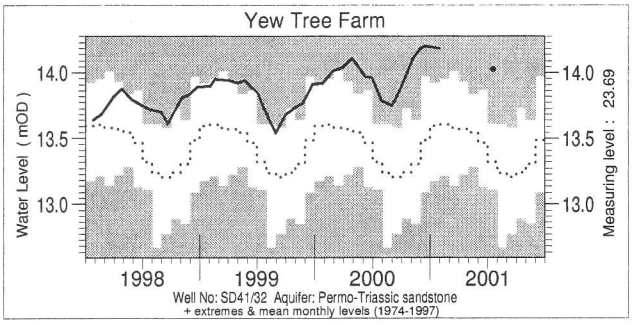
* No March - June groundwater levels available.

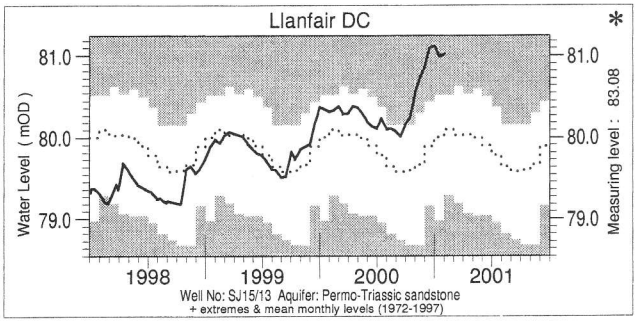
Groundwater . . . Groundwater

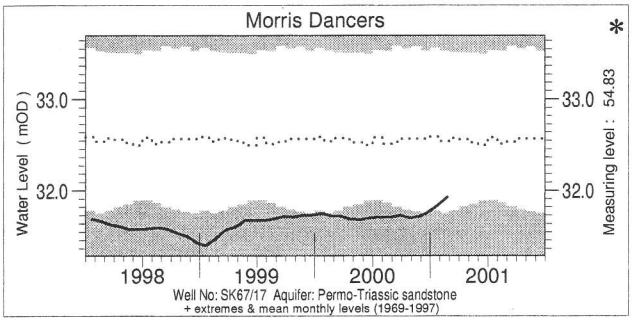


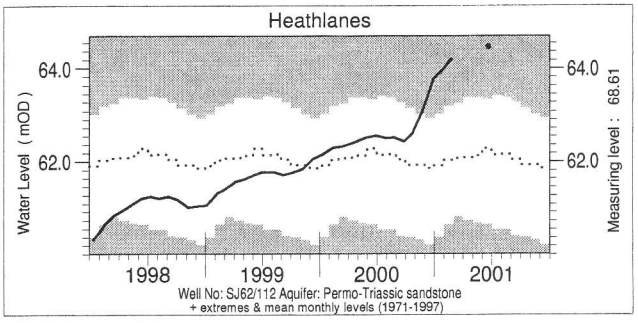


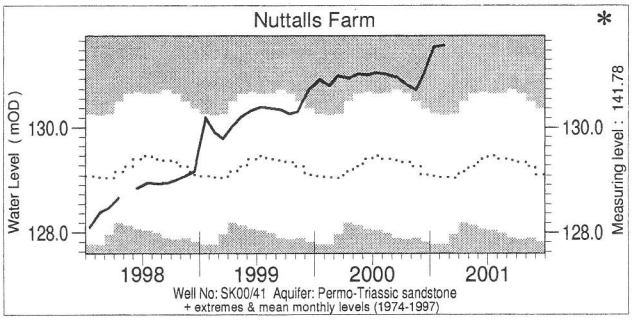


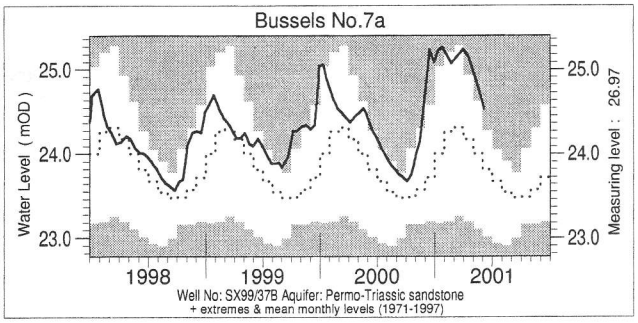


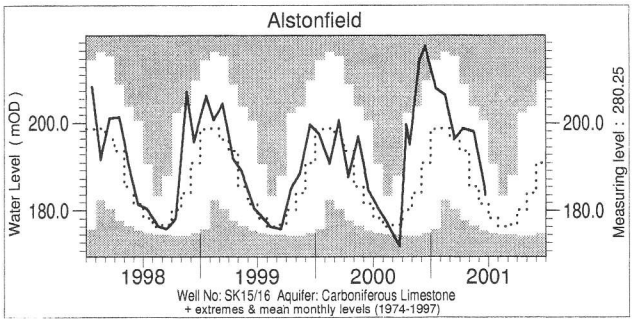










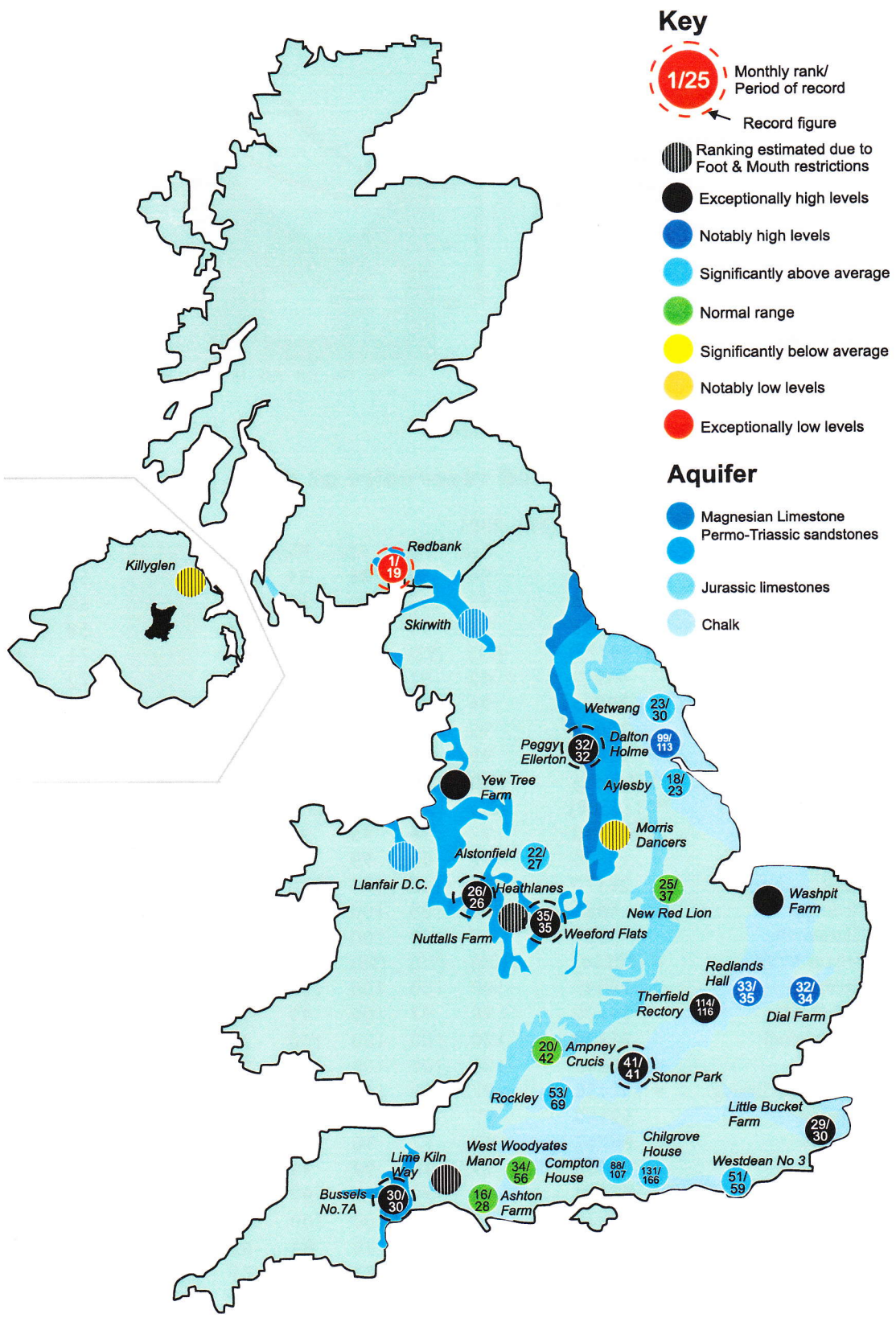


Groundwater levels June / July 2001

Borehole	Level	Date	Jun. av.	Borehole	Level	Date	Jun. av.	Borehole	Level	Date	Jun. av.
Dalton Holme	19.98	22/06	18.13	Chilgrove House	48.12	28/06	46.01	Bussels No 7a	24.53	05/06	23.86
Washpit Farm	48.50	04/07	45.14	New Red Lion	16.04	06/07	14.76	Peggy Ellerton	36.98	27/06	34.35
Stonor Park	89.14	02/07	77.84	Ampney Crucis	100.55	02/07	100.85	Alstonfield	183.58	22/06	181.10
Dial Farm	26.20	01/06	25.69	Redbank	7.11	29/06	7.95				
Rockley	135.86	02/07	134.56	Yew Tree Farm	14.01	06/07	13.54				
Little Bucket Farm	81.32	30/06	71.18	Heathlanes	64.49	19/06	62.16	Data missing due to Foot & Mouth restrictions			
West Woodyates	81.70	30/06	80.90	Weeford Flats	91.67	14/06	89.98				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

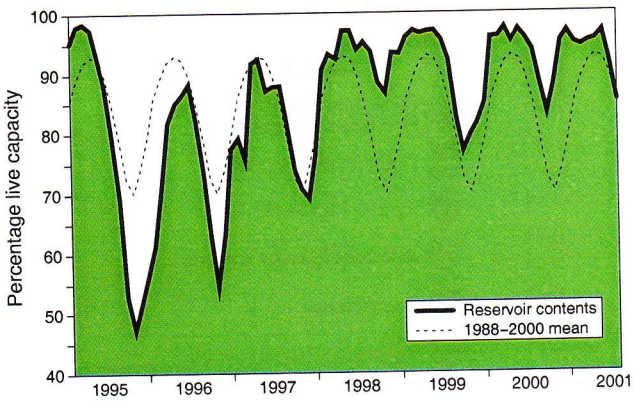


Groundwater levels - June 2001

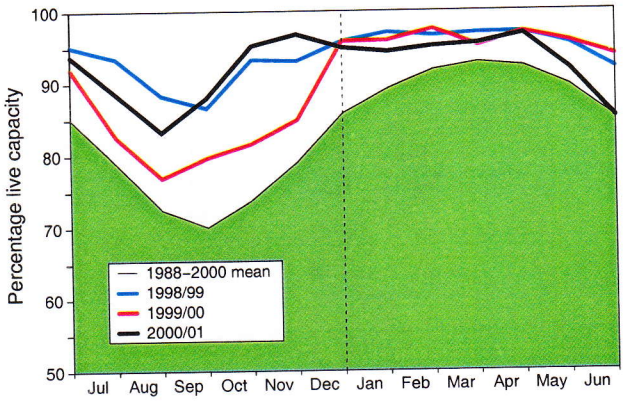
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

(Note: Redbank is affected by groundwater abstraction)

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

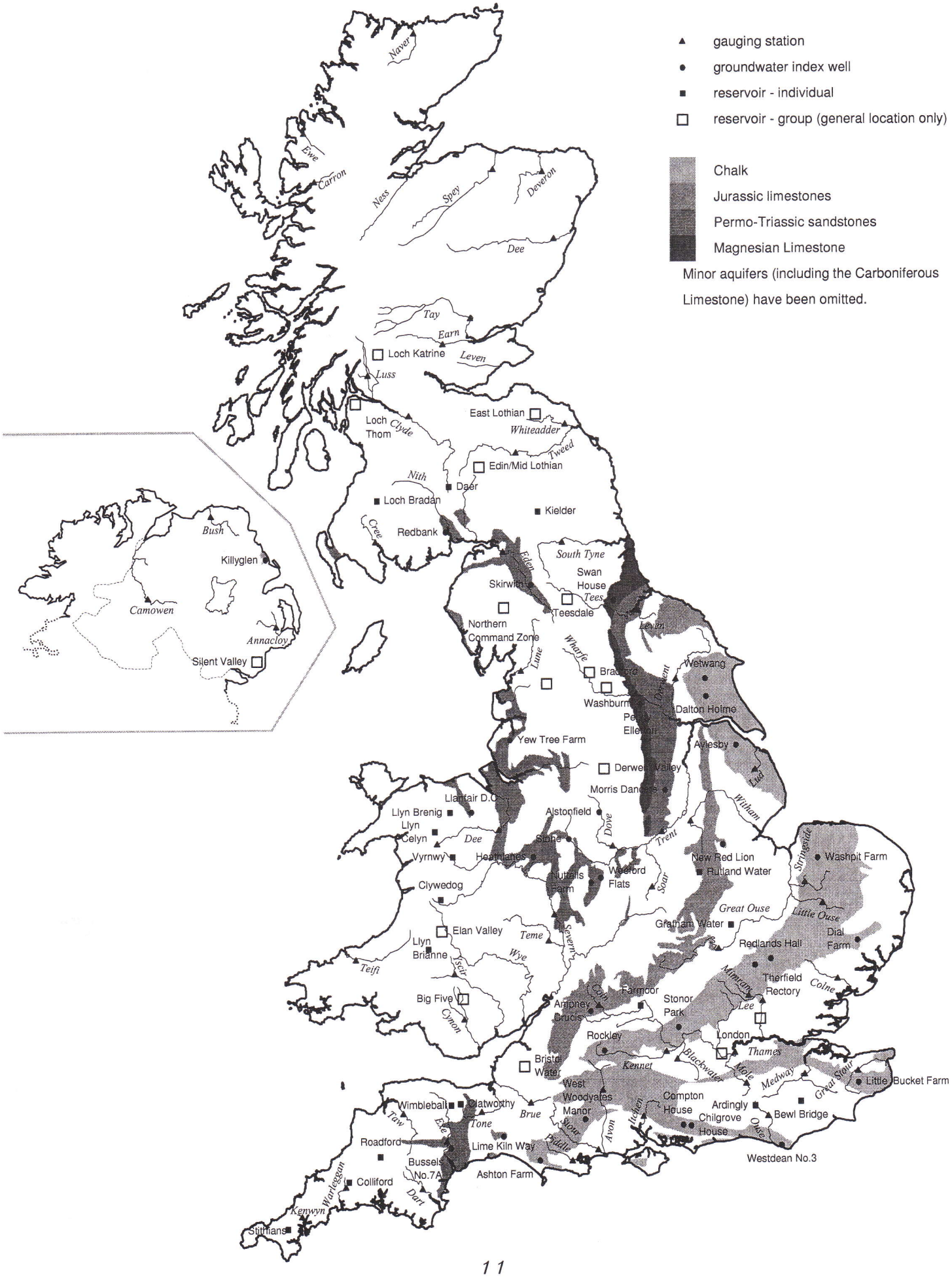
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2001 Feb	Mar	Apr	May	Jun	Jul	Min. Jul	Year* of min
North West	N Command Zone	• 124929	94	94	85	89	73	61	58	1995
	Vyrnwy	55146	93	98	100	99	90	80	65	1990
Northumbrian	Teesdale	• 87936	97	91	92	98	84	76	58	1989
	Kielder	(199175)	(91)	(92)	(92)	(91)	(90)	(88)	71	1989
Severn Trent	Clywedog	44922	82	91	99	98	90	80	72	1989
	Derwent Valley	• 39525	94	98	100	100	97	80	53	1996
Yorkshire	Washburn	• 22035	95	97	99	97	89	81	63	1995
	Bradford supply	• 41407	99	97	99	99	85	77	54	1995
Anglian	Grafham	** (55490)	(88)	(88)	(92)	(96)	(96)	(95)	70	1997
	Rutland	**(116580)	(86)	(92)	(95)	(99)	(96)	(90)	75	1997
Thames	London	• 202340	97	96	95	97	98	94	85	1990
	Farmoor	• 13830	72	81	90	98	98	98	94	1995
Southern	Bewl	28170	100	100	100	100	98	93	52	1990
	Ardingly	4685	100	100	100	100	100	96	86	1996
Wessex	Clatworthy	5364	97	100	100	100	87	75	61	1995
	Bristol WW	• (38666)	(100)	(98)	(98)	(98)	(94)	(83)	64	1990
South West	Colliford	28540	100	100	100	100	97	91	51	1997
	Roadford	34500	98	97	100	99	95	91	49	1996
	Wimbleball	21320	100	100	100	100	94	82	63	1992
	Stithians	5205	100	100	100	100	94	83	53	1990
Welsh	Celyn and Brenig	• 131155	97	99	100	100	100	96	77	1996
	Brianne	62140	97	95	97	100	94	85	76	1995
	Big Five	• 69762	97	97	98	97	89	76	61	1989
	Elan Valley	• 99106	99	98	99	99	94	86	75	1989
East of Scotland	Edinburgh/Mid Lothian	• 97639	99	99	97	97	91	82	54	1998
	East Lothian	• 10206	100	100	100	100	100	93	81	1992
West of Scotland	Loch Katrine	• 111363	94	95	88	83	66	61	61	2001
	Daer	22412	100	100	93	96	81	70	62	1994
	Loch Thom	• 11840	100	98	93	89	74	70	69	2000
Northern Ireland	Silent Valley	• 20634	95	96	100	93	83	72	54	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 1988-2000 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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Maclean Building
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Selected text and maps are available on the WWW at http://www.nwl.ac.uk/ih

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