Hydrological Summary for the United Kingdom

January 2003

General

January was notable for an exceptional range of weather conditions – very mild interludes punctuating lengthier cold spells with damaging blizzards on occasions. For the UK as a whole, precipitation was very close to the January average but hydrological conditions were more a reflection of very high antecedent wetness and a few notable storm events accounting for the bulk of the January rainfall total. Accordingly, river flows displayed wide temporal variations through a month which began with remarkably high flows, and extensive flooding, across much of southern Britain – in a few catchments flows were the highest since the very widespread flooding in March 1947. The continuing need to provide flood alleviation storage constrained increases in reservoir stocks in some areas but for England Wales as a whole, stocks remain very healthy – around 5% below capacity. Similarly, groundwater levels approached seasonal maxima throughout many major aquifer units in January. Echoing early 2001, groundwater flooding was experienced in some chalk outcrop areas – signalling both the exceptional health of groundwater resources, and the continuing risk of flooding (both surface and groundwater).

Rainfall

Contrasting synoptic patterns during January produced airflows across the British Isles from many points of the compass – resulting in large and abrupt temperature changes, and a very uneven distribution of precipitation. In some southern areas >65% of the January total fell on the first and last days. Snow constituted a significant proportion of the total in parts of northern Britain (in eastern Scotland especially) and London had appreciable falls on the 8th and 30th – the latter associated with massive transport disruption. Of greater hydrological significance was the continuation of a very wet spell in late December. Some localities in central southern England reported the equivalent of 6-8 weeks of average winter rainfall over the 12 days beginning on the 21/12. Widespread rainfall on New Year's Day – Culdrose (Cornwall) reported 48 mm in 24 hrs - ensured that the, already notable, flooding would become more extensive and protracted. Subsequently, the relative infrequency of westerly frontal systems resulted in generally below average January rainfall totals in the west – parts of Cornwall recorded <60% whilst much of eastern England registered well above average totals, approaching 200% in parts of East Anglia. Much of northern Scotland was also wet, but rainfall deficiencies – which began in the late summer of 2002 - continue to build in some western catchments and islands. By contrast, rainfall over the Oct. 2002-Jan. 2003 period exceeds 150% of the 1961-90 average in a zone from Anglia to Wessex and the 4-month total for England and Wales ranks 4th highest in the 237-year national series.

River Flow

2003 began dramatically with many rivers exercising a natural right of dominion over their floodplains. Flows exceeded bankfull in many catchments and flood warnings (peaking at >300 on the 2nd) applied across much of the river network in southern Britain – affecting many localities that were also flooded in late 2000. The Dorset Stour recorded its highest Jan. flow on record and some previous maxima were eclipsed (e.g. on the Thame in Oxfordshire). Over 450 properties were flooded in the Thames Valley as the river – in its middle reaches – reached it highest level since the snowmelt flood of March 1947. Locally, flood risks were exacerbated by drainage problems and direct runoff from farmland. However, given the antecedent rainfall and the magnitude of the peak flows, flooding of properties was relatively modest. Nonetheless, the onset of anticyclonic conditions provided a very welcome respite, heralding sustained recessions in most rivers. In permeable eastern and southern catchments, these were partly compensated for by rapidly rising baseflow contributions which helped ensure well above average January runoff totals across the English Lowlands – particularly in East Anglia and Thames regions (river establishing new max. January flows included the Little Ouse and Kennet). By contrast, runoff in most western and northern catchments (where frozen conditions resulted in very low flows in mid-month) was below average, albeit well within the normal winter range.

Groundwater

High pressure throughout the two weeks from the 3rd January produced the longest spell without significant infiltration since September in some lowland outcrop areas. Nonetheless, with catchments saturated and rainfall (for the 7thth successive month in some areas) broadly favouring the eastern outcrop areas, January infiltration totals exceeded the average throughout most major aquifers – a few western Permo-Triassic sandstones outcrops excepted. But levels in all but the most responsive aquifers reflect infiltration rates over several months (at least) and, since September, infiltration has exceeded twice the average over a significant proportion of the eastern Chalk (e.g. in parts of the North Downs and Chilterns). Since 1960, only in late 2000 has there been an appreciably more abundant autumn/early winter recharge episode. The impact of the two recent exceptional episodes is evident in the groundwater level hydrographs. January levels in most Chalk outcrop areas were close to seasonal maxima, and unprecedented in some areas (e.g. parts of the Yorkshire Wolds and at Rockley). Levels are generally notably high in most of the (more responsive) limestone outcrops and still exceed pre-2000 maxima in a few parts of the Permo-Triassic sandstones (e.g. Llanfair DC).

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

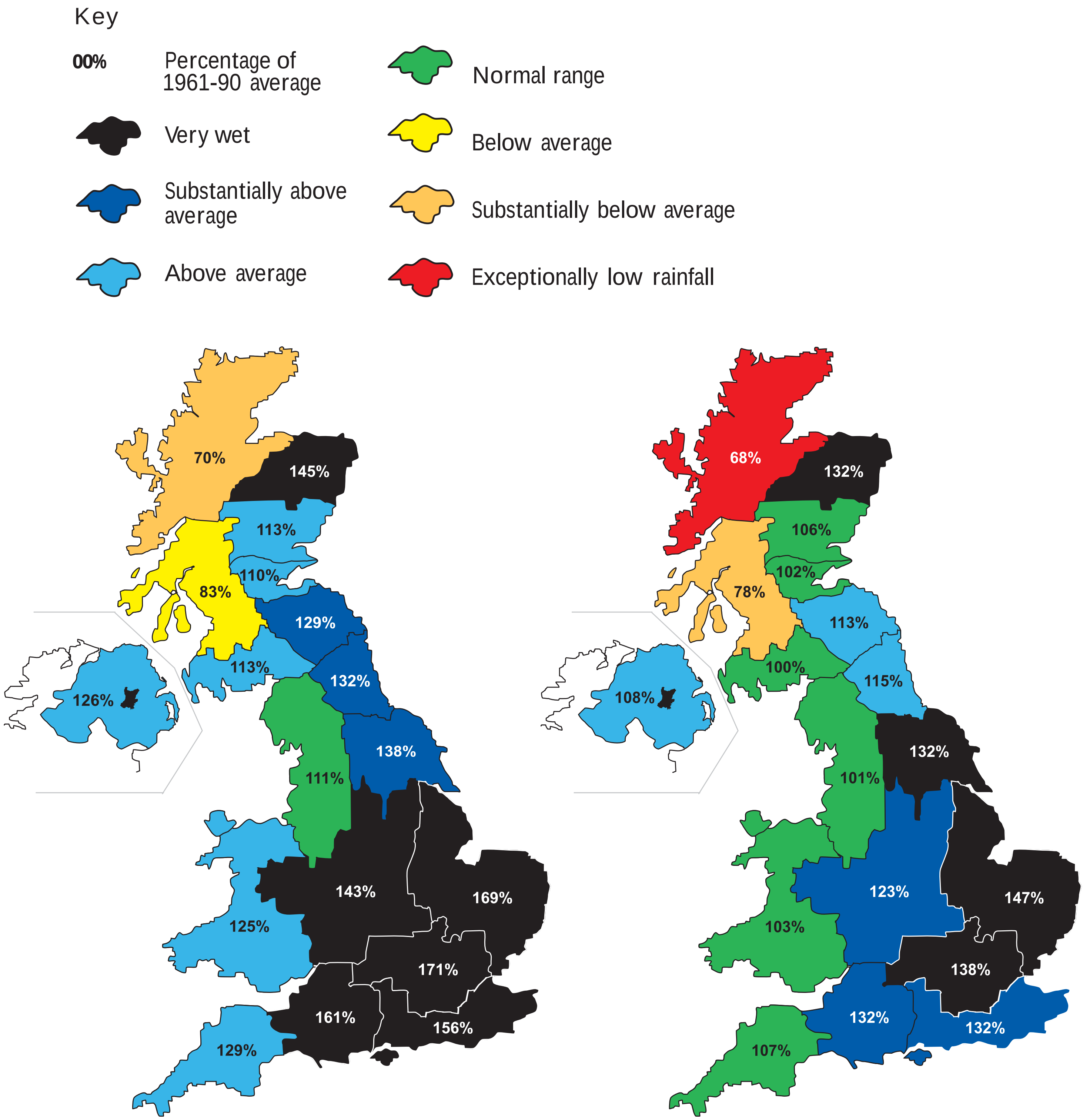
Area	Rainfall	Jan 2003	Oct 02-Jan 03	RP	Jul 02-Jan 03	RP	Feb 02-Jan 03	RP	Feb 01-Jan 03	RP
England & Wales	**mm**	**91**	**559**		**769**		**1122**		**2095**	
	%	**100**	**153**	**50-80**	**132**	**30-40**	**123**	**20-30**	**115**	**10-20**
North West	mm	97	552		808		1396		2536	
	%	80	111	2-5	101	2-5	116	5-10	105	2-5
Northumbrian	mm	87	432		629		1005		1846	
	%	103	132	5-15	115	5-10	118	5-15	108	2-5
Severn Trent	mm	61	402		572		876		1660	
	%	87	143	15-25	123	5-15	116	5-10	110	5-10
Yorkshire	mm	70	435		683		995		1796	
	%	88	138	10-20	132	20-30	121	10-20	109	5-10
Anglian	mm	71	363		539		750		1477	
	%	141	169	120-170	147	70-100	126	20-30	124	50-80
Thames	mm	79	445		589		892		1669	
	%	124	171	110-150	138	20-35	129	20-35	121	20-35
Southern	mm	86	510		662		982		1826	
	%	107	156	30-50	132	10-20	126	15-25	117	10-20
Wessex	mm	87	552		701		1061		1884	
	%	100	161	40-60	132	10-20	127	15-25	112	5-10
South West	mm	99	666		815		1312		2348	
	%	72	129	5-10	107	2-5	112	2-5	100	<2
Welsh	mm	114	717		898		1484		2804	
	%	80	125	5-10	103	2-5	113	5-10	107	2-5
Scotland	**mm**	**167**	**565**		**825**		**1506**		**2900**	
	%	**111**	**93**	**2-5**	**86**	**5-10**	**105**	**2-5**	**101**	**2-5**
Highland	mm	230	552		806		1592		3204	
	%	122	70	10-20	68	60-90	90	2-5	91	5-10
North East	mm	115	564		837		1207		2190	
	%	116	145	35-50	132	30-45	124	30-45	113	10-20
Tay	mm	128	588		853		1503		2713	
	%	89	113	2-5	106	2-5	122	15-25	110	5-10
Forth	mm	113	502		751		1338		2353	
	%	96	110	2-5	102	2-5	121	15-25	106	2-5
Tweed	mm	102	491		714		1176		2110	
	%	102	129	5-15	113	2-5	121	10-20	109	5-10
Solway	mm	131	682		960		1713		2988	
	%	84	113	2-5	100	<2	121	10-20	105	2-5
Clyde	mm	170	619		906		1780		3307	
	%	90	83	2-5	78	10-20	105	2-5	98	2-5
Northern Ireland	**mm**	**92**	**544**		**743**		**1317**		**2256**	
	%	**83**	**126**	**5-10**	**108**	**2-5**	**124**	**20-30**	**107**	**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 . .

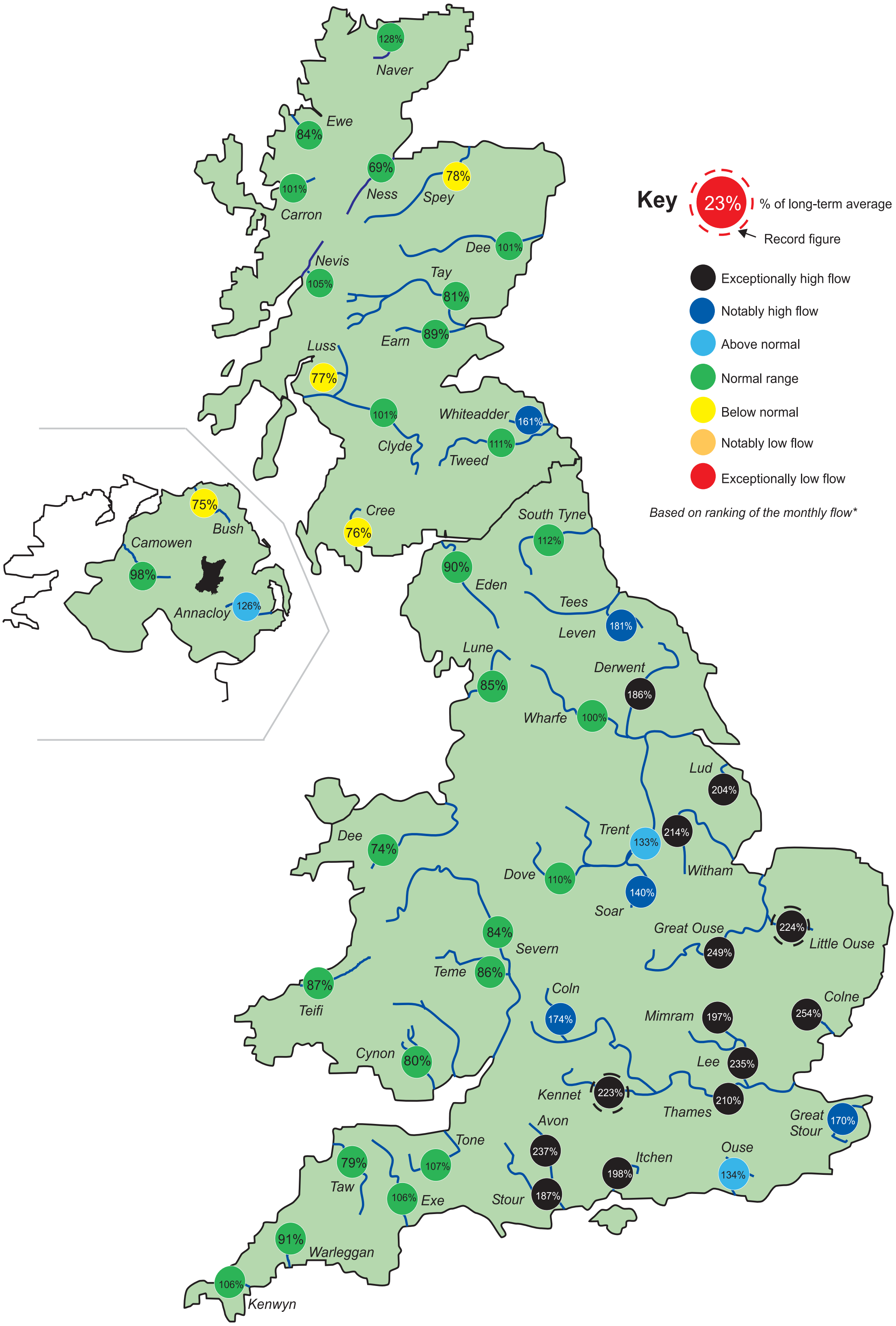


October 2002 - January 2003　　July 2002 - January 2003

Rainfall accumulation maps

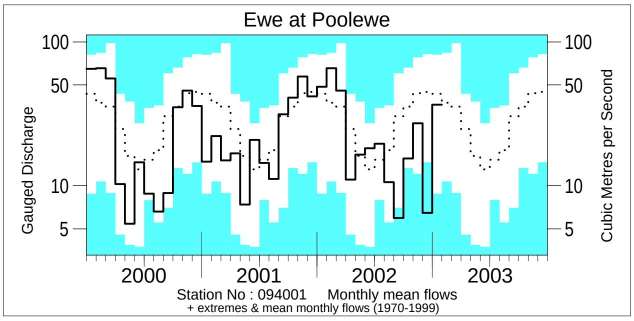
The UK rainfall total for the last four months ranks (provisionally) as the 10th highest in the last 60 years - partly as a result of the notable wetness of much of the English Lowlands; the corresponding total for the Thames catchment is the fourth highest in a series from 1883. For many lowland catchments January was the sixth wet month in the last seven. In stark contrast, the Highland Region in Scotland registered its first above average monthly total since July last year - and parts of western Scotland (e.g. Mull) were again relatively dry).

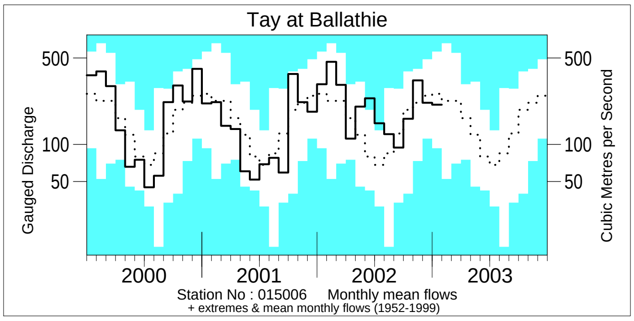
River flow . . . River flow . . .

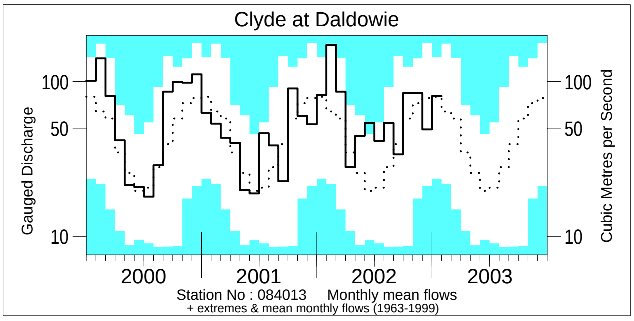


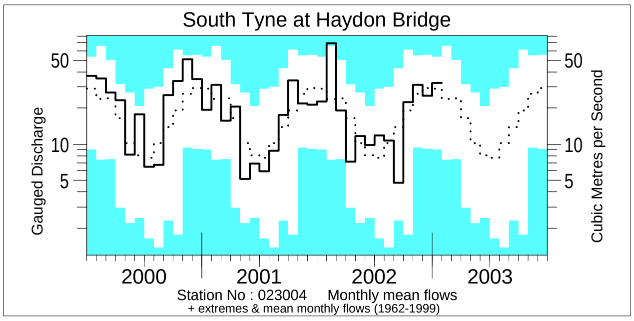
River flows - January 2003

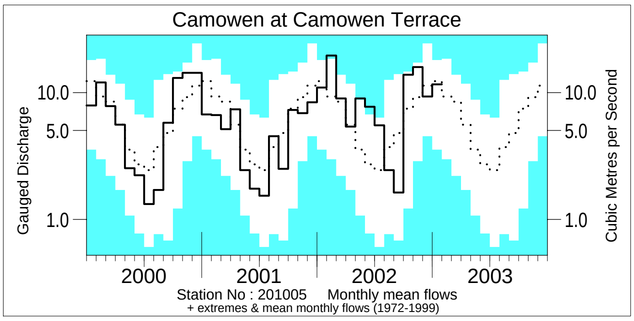
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

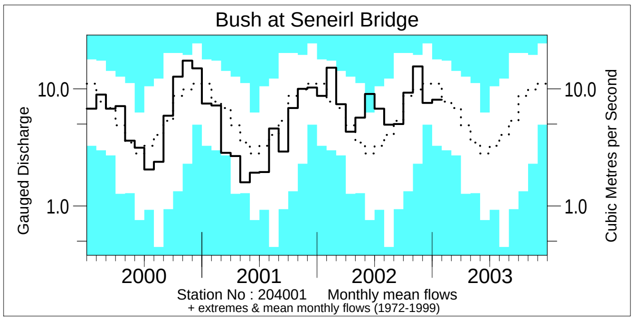


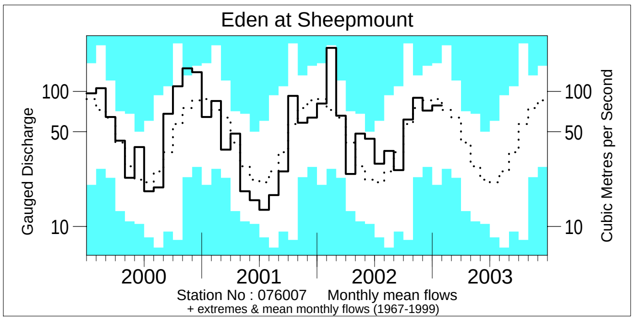


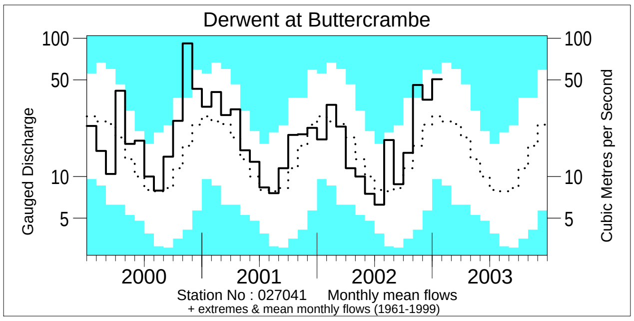


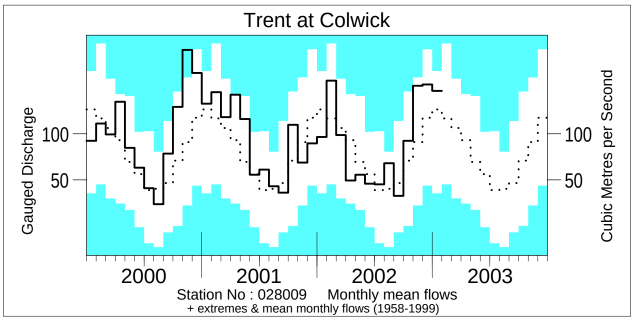


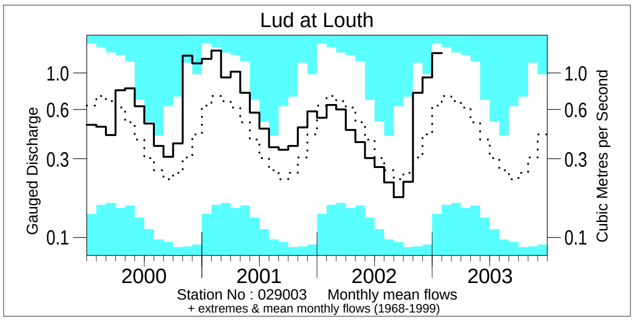






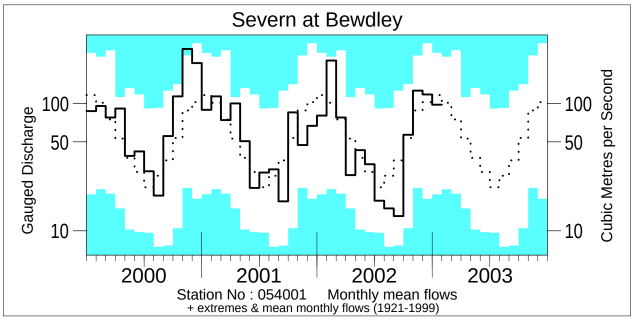


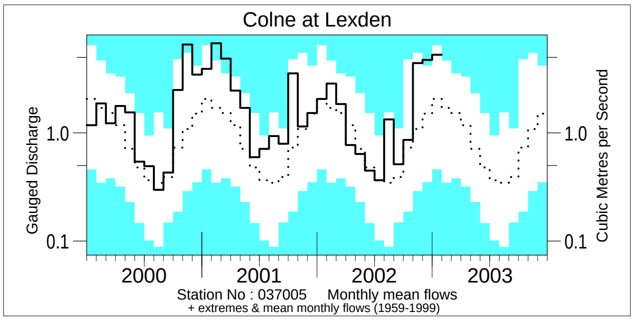


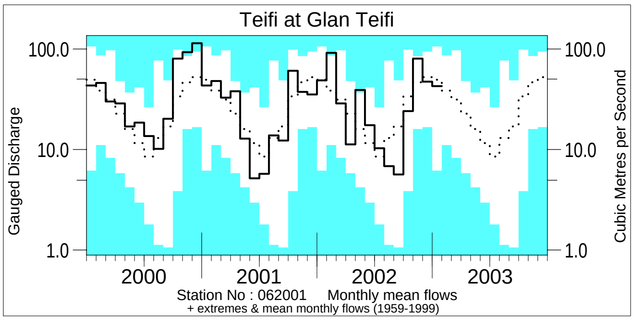


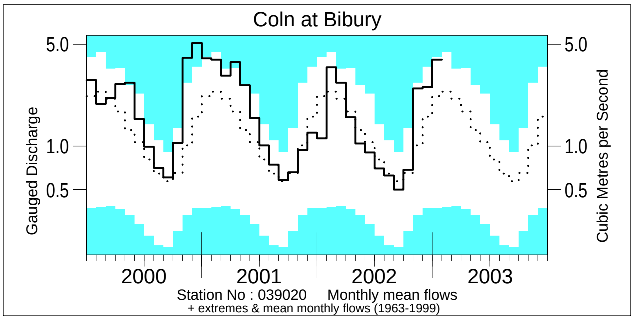
Monthly river flow hydrographs

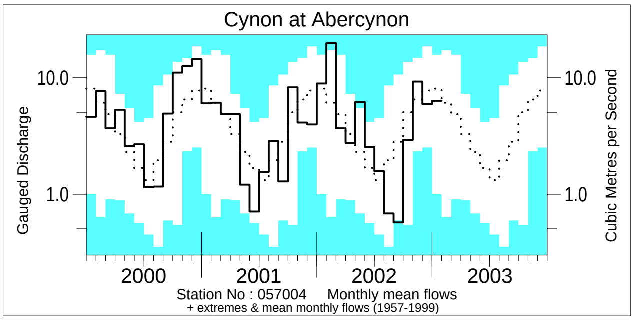
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

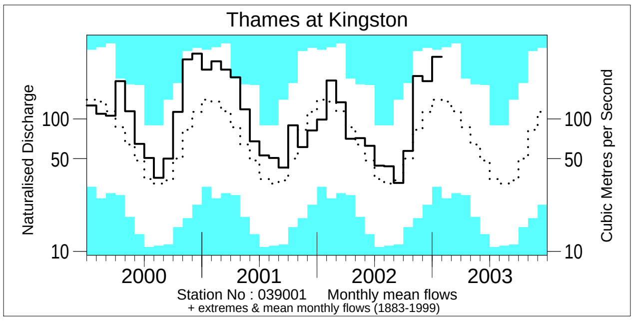


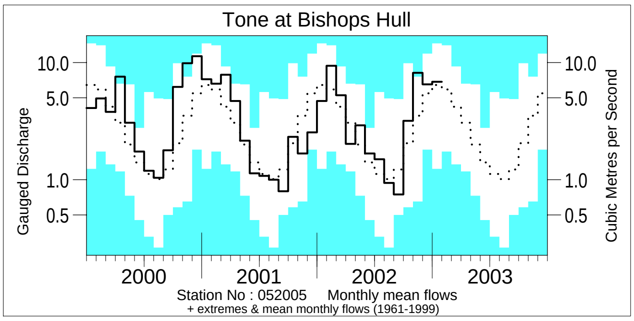


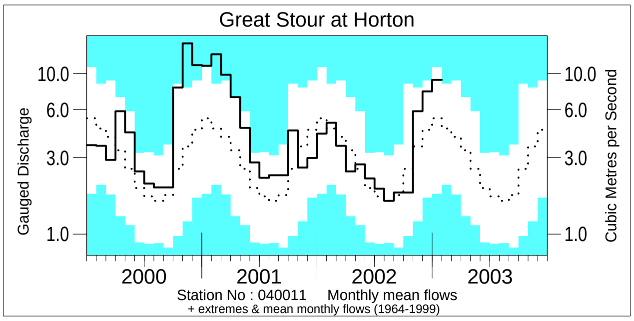


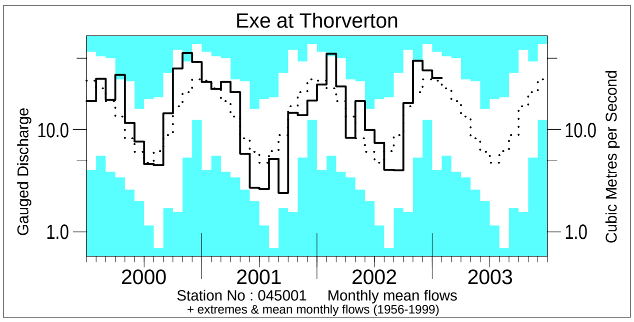


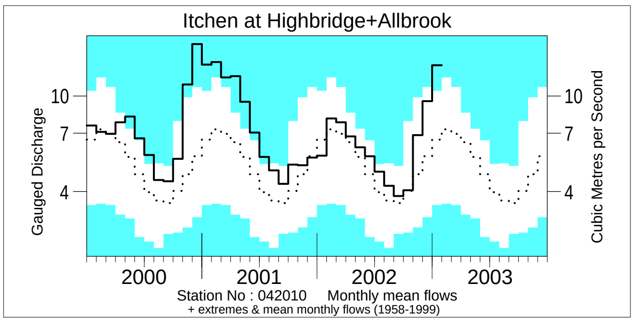












Notable runoff accumulations (a) October 2002 - January 2003, (b) July 2002 - January 2003

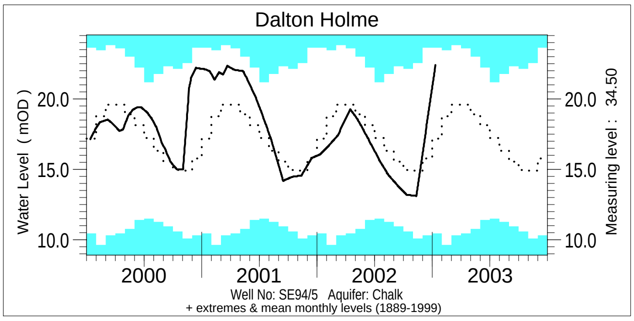
	River	%lta	Rank
a)	Dee	175	30/30
	Whiteadder	220	34/34
	Derwent	176	41/42
	Torne	201	31/31
	Bedford Ouse	240	69/70
	Stringside	248	37/37
	Lee	208	115/118
	Kennet	202	41/42
	Wilts. Avon	230	37/38

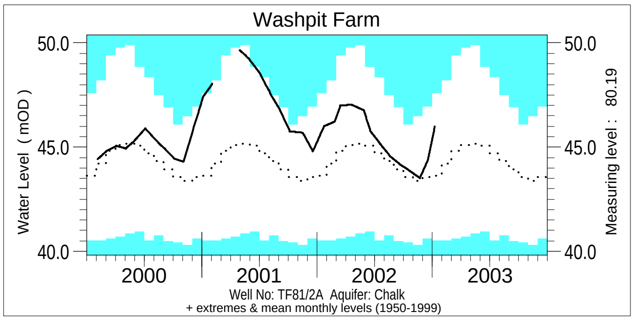
River	%lta	Rank
Otter	169	40/41
Brue	173	36/37
Luss	70	1/24
Nevis	67	1/21
Carron	51	1/24
Ewe	51	1/32
Annacloy	187	23/23

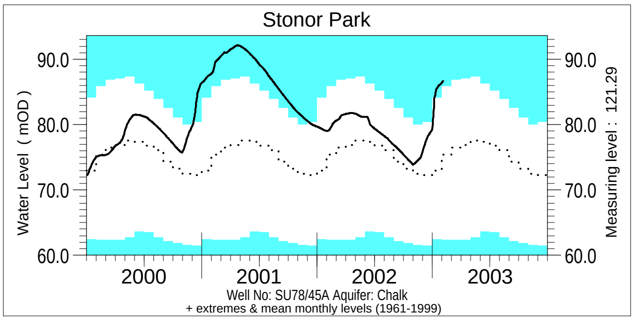
	River	%lta	Rank
b)	Ness	62	2/30
	Deveron	168	40/40
	Dover Beck	194	27/27
	Witham	226	43/44
	Blackwater	167	49/50
	Lymington	226	39/40
	Stour (Dorset)	196	29/30

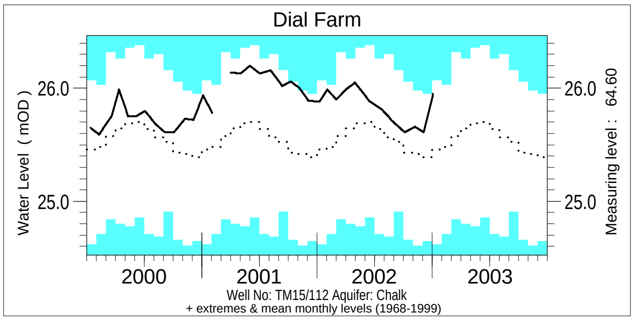
lta = long term average
Rank 1 = lowest on record

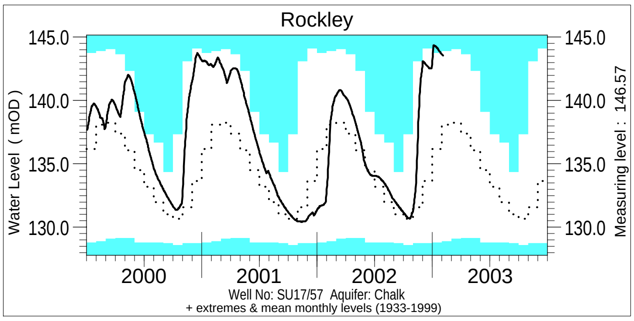
Groundwater . . . Groundwater

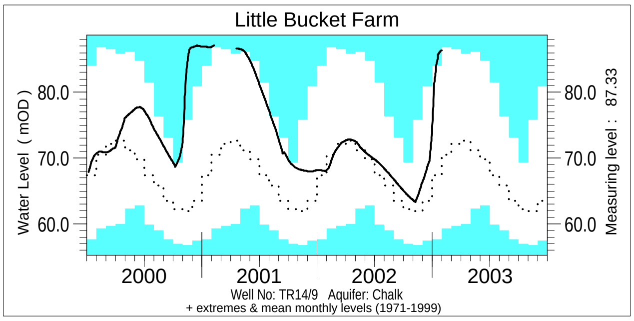


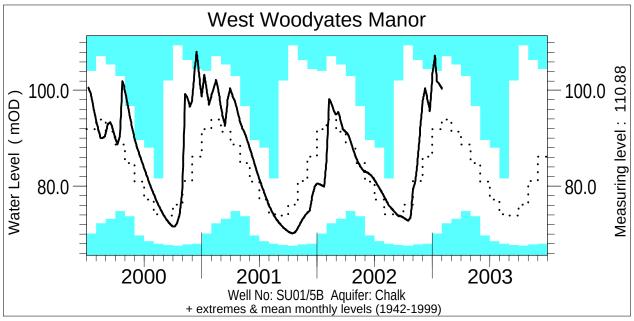


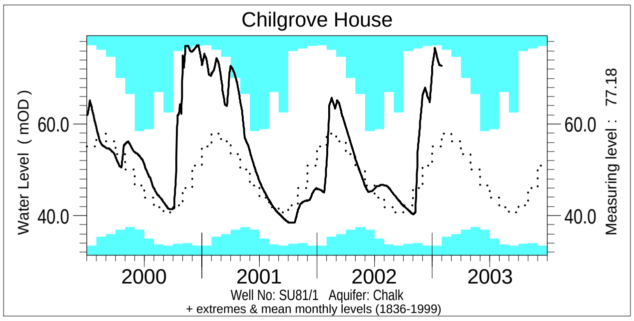


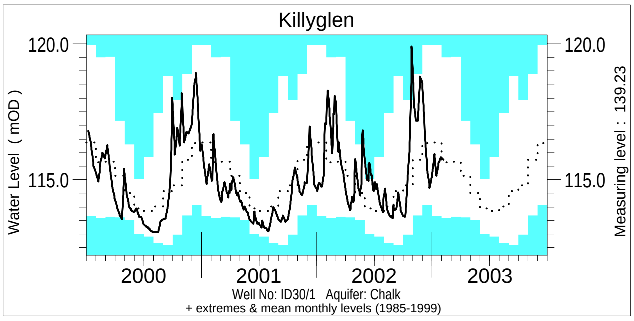


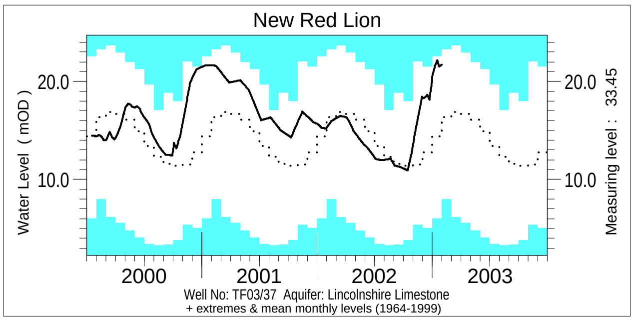






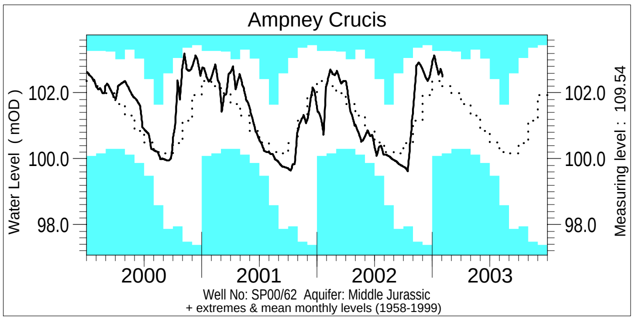


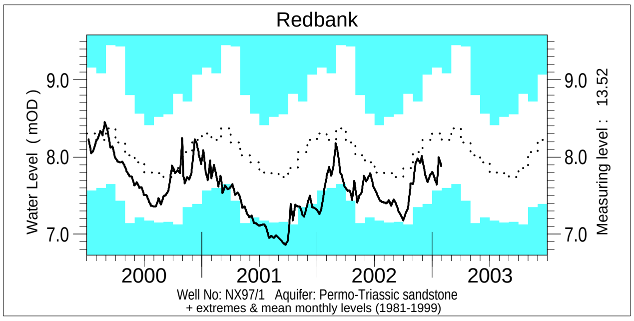


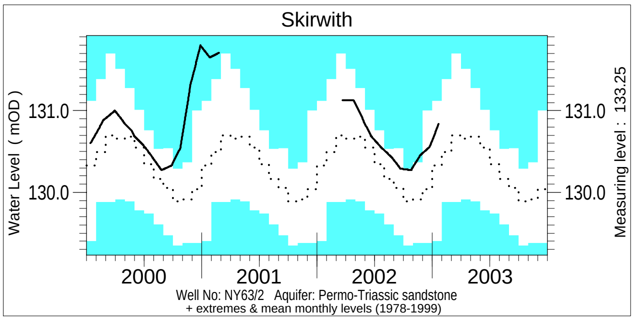


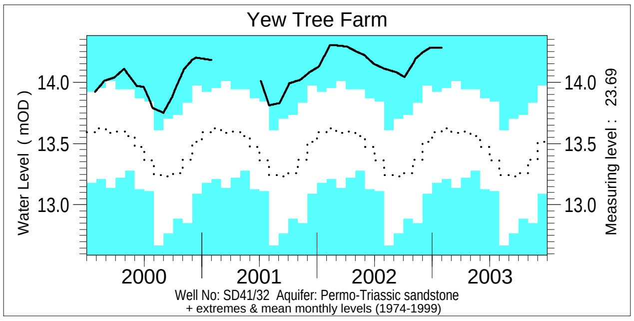
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

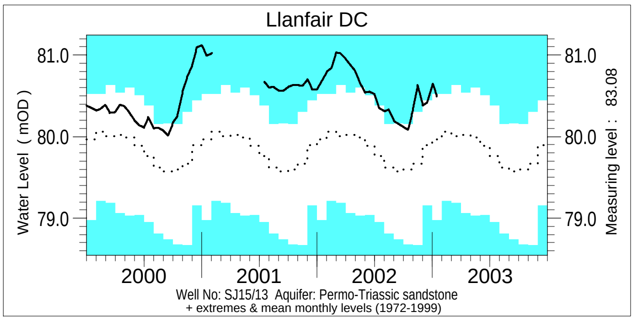
Groundwater . . . Groundwater

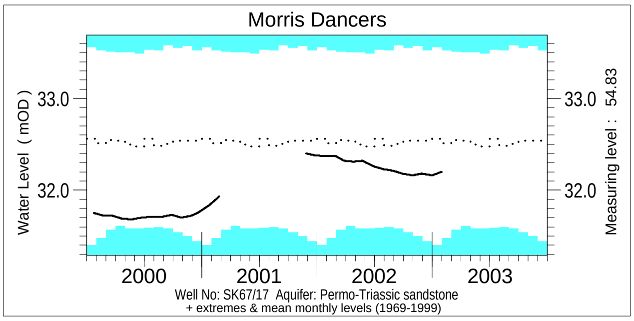


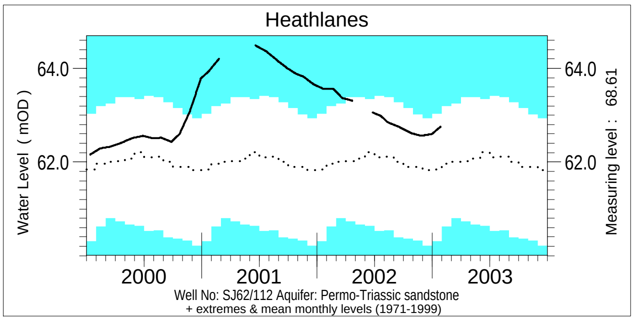


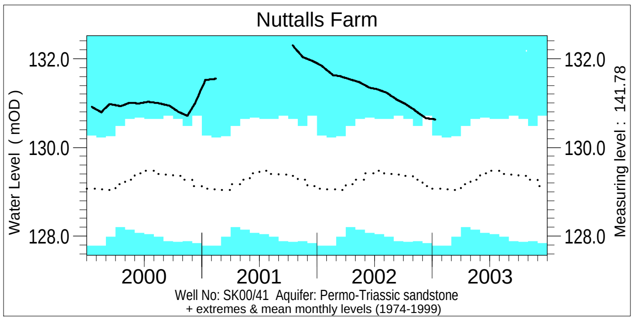


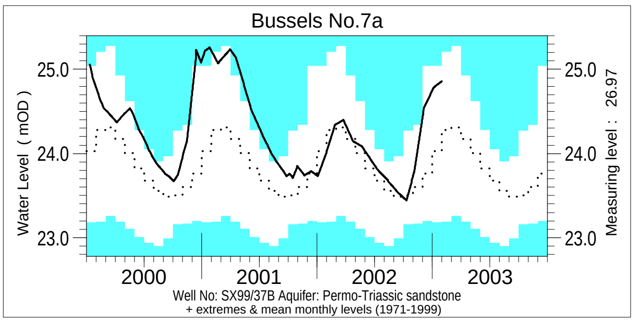


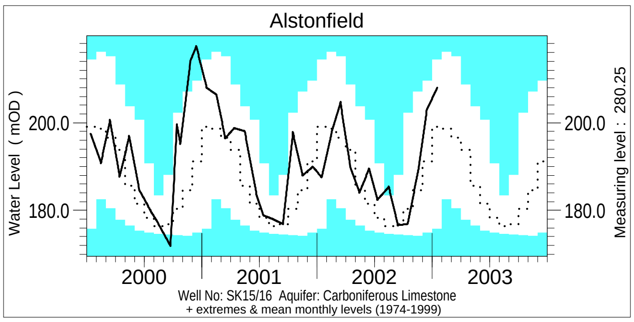










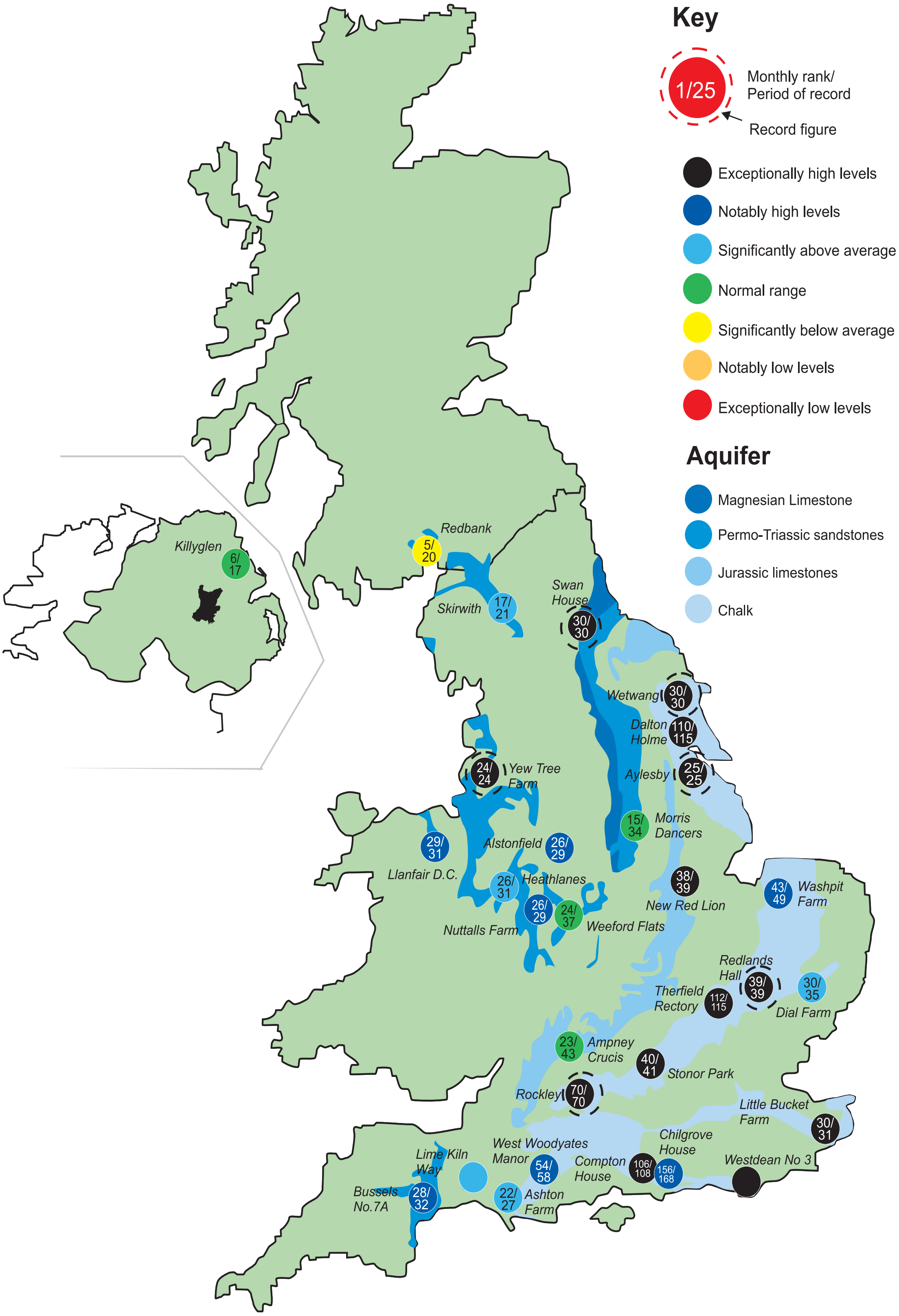


Groundwater levels January 2003 / February 2003

Borehole	Level	Date	Jan. av.	Borehole	Level	Date	Jan. av.	Borehole	Level	Date	Jan. av.
Dalton Holme	22.40	09/01	17.19	Chilgrove House	72.74	31/01	56.12	Llanfair DC	80.49	15/01	79.93
Washpit Farm	45.98	07/01	43.72	Killyglen	115.73	05/02	116.17	Morris Dancers	32.20	30/01	32.39
Stonor Park	86.70	03/02	73.57	New Red Lion	21.74	31/01	14.70	Heathlanes	62.76	27/01	61.94
Dial Farm	25.95	02/01	25.49	Ampney Crucis	102.49	02/02	102.32	Nuttalls Farm	130.63	10/01	129.46
Rockley	143.54	03/02	136.24	Redbank	7.88	29/01	8.28	Bussels No.7a	24.86	30/01	24.12
Little Bucket Farm	86.33	31/01	68.12	Skirwith	130.84	20/01	130.42	Alstonfield	208.05	15/01	199.22
West Woodyates	100.36	31/01	91.46	Yew Tree Farm	14.28	30/01	13.63				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



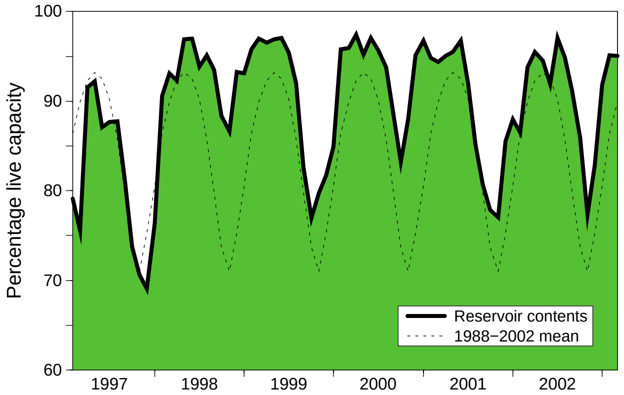
Groundwater levels - January 2003

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.

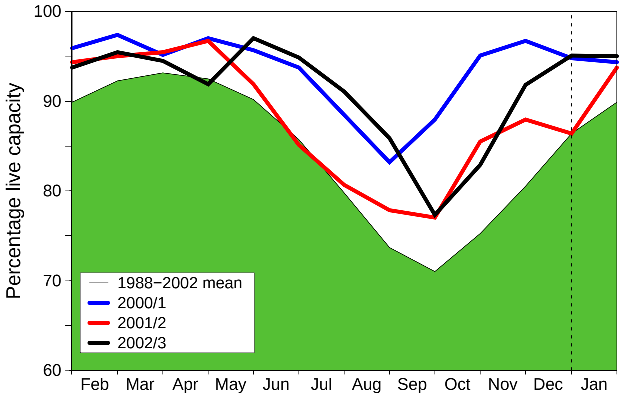
(Note: Redbank is affected by groundwater abstraction.)

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.

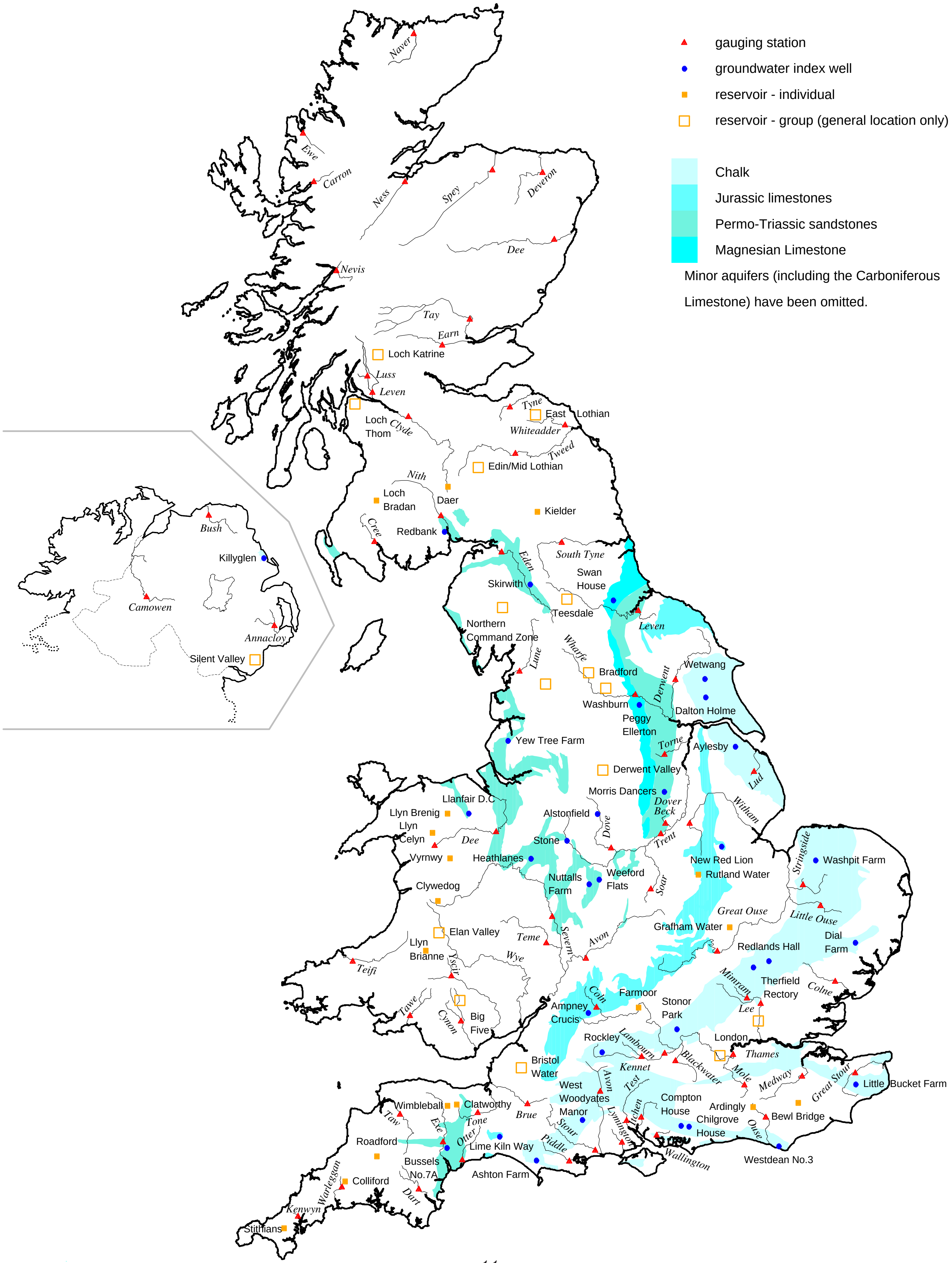
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2002 Sep	Oct	Nov	Dec	2003 Jan	Feb	Min. Feb	Year* of min.
North West	N Command Zone	• 124929	78	68	66	79	86	**93**	63	1996
	Vyrnwy	55146	77	62	86	99	99	**94**	45	1996
Northumbrian	Teesdale	• 87936	87	77	89	92	93	**93**	51	1996
	Kielder	(199175)	(91)	(86)	(94)	(90)	(99)	**(99)**	(85)	1989
Severn Trent	Clywedog	44922	85	71	86	78	88	**81**	62	1996
	Derwent Valley	• 39525	84	78	95	99	100	**98**	15	1996
Yorkshire	Washburn	• 22035	84	75	89	90	99	**97**	34	1996
	Bradford supply	• 41407	92	83	95	100	100	**100**	33	1996
Anglian	Grafham	(55490)	(94)	(89)	(88)	(90)	(89)	**(84)**	(67)	1998
	Rutland	(116580)	(88)	(85)	(89)	(94)	(93)	**(90)**	(68)	1997
Thames	London	• 202340	92	81	84	96	97	**97**	70	1997
	Farmoor	• 13830	95	91	83	94	91	**91**	72	2001
Southern	Bewl	28170	85	78	73	80	86	**92**	47	1990
	Ardingly	4685	98	92	88	100	100	**100**	68	1997
Wessex	Clatworthy	5364	76	62	73	100	100	**100**	62	1989
	Bristol WW	• (38666)	(78)	(71)	(78)	(93)	(99)	**(98)**	(58)	1992
South West	Colliford	28540	74	63	63	71	78	**81**	52	1997
	Roadford	34500	90	83	82	91	95	**92**	30	1996
	Wimbleball	21320	86	73	80	98	100	**100**	59	1997
	Stithians	5205	68	54	55	84	100	**99**	38	1992
Welsh	Celyn and Brenig	• 131155	93	88	90	94	96	**96**	61	1996
	Brianne	62140	89	80	83	98	99	**99**	84	1997
	Big Five	• 69762	69	53	62	89	96	**99**	67	1997
	Elan Valley	• 99106	75	64	68	100	100	**100**	73	1996
Scotland(E)	Edinburgh/Mid Lothian	• 97639	92	88	89	94	95	**99**	72	1999
	East Lothian	• 10206	96	92	100	99	99	**100**	68	1990
Scotland(W)	Loch Katrine	• 111363	83	74	77	88	89	**97**	85	2000
	Daer	22412	97	94	100	100	100	**99**	91	1997
	Loch Thom	• 11840	94	87	100	100	100	**100**	93	1998
Northern Ireland	Total[+]	•	88	79	94	100	99	**98**	69	2002
	Silent Valley	• 20634	79	69	93	100	98	**98**	46	2002

() figures in parentheses relate to gross storage • denotes reservoir groups [+]excludes Lough Neagh *last occurrence - see footnote

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 1988-2003 period only (except for West of Scotland and Northern Ireland where data commence in the mid-1990's). 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 for Environment, Food and Rural Affairs (DEFRA), 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, Scottish Water 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.

Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

Hydrological Summaries
National Water Archive
CEH Wallingford
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
Tel.: 01491 838800
Fax: 01491 692424

Selected text and maps are available on the WWW at http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

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NATURAL ENVIRONMENT RESEARCH COUNCIL

01/03