Hydrological summary
for the United Kingdom

July 2002

General

Rainfall patterns in July often display limited spatial coherence but this year the regional and local variability was exceptional. Below average rainfall characterised some western catchments and the mid-month period was exceptionally dry over wide areas - triggering increased irrigation demands and garden watering. In the Shetlands, water was tankered to the Out Skerries to augment dwindling stocks. Overall however, July was considerably wetter than average and intense storms caused flooding in many localities. Heavy surface runoff and landslides also contributed to massive transport disruption, in Scotland especially. Significant replenishment around month-end boosted stocks in most index reservoirs to well above 80% of capacity. Overall stocks for England and Wales are the second highest for early August since national monitoring began in 1988. Notwithstanding large within-month flow variation most July runoff totals were well above average and groundwater levels throughout the major aquifers were close to, or above, the late summer average. The water resources outlook for the remainder of the summer remains very healthy.

Rainfall

July was a month of exceptional regional and local variations in rainfall. Some catchments in central England reported sequences of 20 dry days; by contrast parts of Scotland (e.g. the Trossachs) registered rainfall on all but two or three days. More hydrologically notable was the intensity of the storms which affected many parts of the UK – notable rainfalls were reported over periods ranging from a few minutes to several days (and longer). Almost half of a 53 mm storm total at Sutton Bonnington (Notts) on the 20/21st fell in 2 hours whilst in the Grampian region 2-day totals reached 70 mm (e.g. at Scotsmill). Thunderstorms were very widespread following the breakdown of a short heatwave approaching month-end. On the 30th, Alston (Cumbria) reported 26.2 mm in 15 minutes (estimated return period >50 yrs), Kirklees (West Yorks) 50 mm in 4 hrs (50 yrs), Leuchars (Fife) 49 mm in 3hrs (>200 yrs) and Charnwood Forest (Leics) 103 mm in around 6 hrs (>300yrs). In Norfolk, a total of 83 mm (from two storms) was registered over an 18-hour period at Marham. The contribution of convective rainfall is reflected in the large spatial variation in rainfall anomalies for July. Parts of Wales were relatively dry, particularly in the north – but to the east and north many catchments registered well above average rainfall, exceeding 250% in parts of the East Midlands and eastern Scotland – Leuchars reported its wettest July in a 80-year rainfall series. A few eastern coastal areas escaped the storms but provisional regional rainfall totals were well above average throughout the English Lowlands. Regional rainfall accumulations are generally well above average over the 3-month timespan, and exceptionally high for the year thus far (eastern England excepted). The provisional Jan-July rainfall totals for Scotland ranks second highest (after 1990) in a 134-year record; the corresponding total for Northern Ireland is unprecedented in a series from 1900.

River Flows

In many catchments, river flows during July spanned an unusually large range for the summer. Modest mimima were recorded in many responsive western rivers during the fourth week but notable summer spates (especially around month-end) triggered flood warnings and, mostly minor, floodplain inundations across northern Britain especially. On the 30th, the Tay and Clyde reported their highest July flows in records of >35 years; rivers draining the Pennines were in high spate also. Some fluvial flooding was severe (e.g. at Glossop on the Etherow) but, more commonly, rainfall intensities overwhelmed urban drainage capabilities generating severe flash flooding e.g. in Belfast (12th), Nottingham (20th), Glasgow (30th) and West Yorkshire (30th). Evacuation of residents from stricken areas was necessary (e.g. Glasgow, the Trossachs, Lincoln) and road/tunnel flooding disrupted transport services over wide areas. July runoff totals exceeded the average throughout most of the UK and some July maxima were elipsed (e.g. the Dee in north east Scotland). Below average July flows typified many Welsh rivers and in a few sheltered eastern catchments longer term deficiencies have developed – the March-July runoff total for the Leven (Cleveland) was the second lowest since 1976. Much more generally, runoff accumulations are very healthy with Jan-July runoff totals exceptionally high in many regions (the Cree, Eden, Luss and Dart are among many rivers which established new Jan-July maxima).

Groundwater

Soil moisture deficits had been eradicated across most northern and western regions of the UK by early August – an unusual circumstance, in recent years particularly. However, over most major aquifer outcrop areas significant deficits remained – albeit well below the late summer average. Sustained storm rainfall did produce local infiltration (which is not fully reflected in the groundwater hydrographs – many index wells having reported early-July levels) but its impact on overall groundwater resources was minimal. The benefit of the recent rainfall is expected to manifest itself in an early seasonal onset of recharge during the autumn. In the Chalk, isolated and modest groundwater level recoveries were reported in July (e.g. for Chilgrove) but generally the late summer recessions continued with groundwater levels close to the seasonal average. As throughout most of the late spring and summer, this pattern is repeated in most limestone aquifers and the more responsive Permo-Triassic sandstones units (e.g. Bussels). By contrast groundwater levels, though falling, remain exceptionally high in most Midland and northern PT sandstones index wells.

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

Rainfall accumulations and return period estimates

Area	Rainfall	Jul 2002	May 02-Jul 02	RP	Mar 02-Jul 02	RP	Jan 02-Jul 02	RP	Aug 01-Jul 02	RP
England & Wales	**mm**	**92**	**230**		**328**		**527**		**937**	
	%	**148**	**120**	**2-5**	**100**	**<2**	**109**	**2-5**	**103**	**2-5**
North West	mm	102	323		467		820		1369	
	%	119	134	5-15	115	2-5	135	30-40	114	5-10
Northumbrian	mm	79	224		317		536		925	
	%	121	120	2-5	101	2-5	118	5-10	108	2-5
Severn Trent	mm	85	199		279		451		774	
	%	159	116	2-5	97	2-5	110	2-5	103	2-5
Yorkshire	mm	98	209		290		469		846	
	%	166	117	2-5	95	2-5	106	2-5	103	2-5
Anglian	mm	88	178		245		344		650	
	%	179	120	2-5	102	2-5	105	2-5	109	2-5
Thames	mm	76	207		294		449		775	
	%	155	130	5-10	111	2-5	120	5-10	112	2-5
Southern	mm	69	211		295		473		839	
	%	144	135	5-10	108	2-5	116	2-5	108	2-5
Wessex	mm	71	213		319		523		854	
	%	137	125	5-10	109	2-5	117	5-10	102	2-5
South West	mm	73	266		406		722		1131	
	%	106	126	5-10	107	2-5	117	5-10	96	2-5
Welsh	mm	63	272		430		809		1405	
	%	81	114	2-5	101	2-5	122	5-10	107	2-5
Scotland	**mm**	**125**	**361**		**575**		**1017**		**1663**	
	%	**133**	**136**	**15-25**	**123**	**10-20**	**141**	**>200**	**116**	**10-20**
Highland	mm	140	370		641		1186		1998	
	%	132	125	5-10	117	5-10	137	80-120	114	5-10
North East	mm	138	286		392		616		1106	
	%	189	137	10-20	113	2-5	121	5-15	114	5-10
Tay	mm	127	389		570		991		1528	
	%	165	167	80-120	141	30-45	154	>>200	124	20-35
Forth	mm	107	339		510		852		1299	
	%	142	156	40-60	137	30-45	150	>>200	117	10-20
Tweed	mm	105	273		399		696		1099	
	%	143	131	5-10	116	2-5	136	35-50	113	5-10
Solway	mm	103	408		606		1060		1644	
	%	115	157	50-80	134	20-30	149	>200	116	5-10
Clyde	mm	124	438		710		1250		1989	
	%	113	149	35-50	135	30-40	150	>>200	117	10-20
Northern Ireland	**mm**	**103**	**349**		**516**		**802**		**1203**	
	%	**154**	**167**	**70-100**	**143**	**30-50**	**146**	**110-150**	**114**	**5-10**

RP = Return period

 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 . . .

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

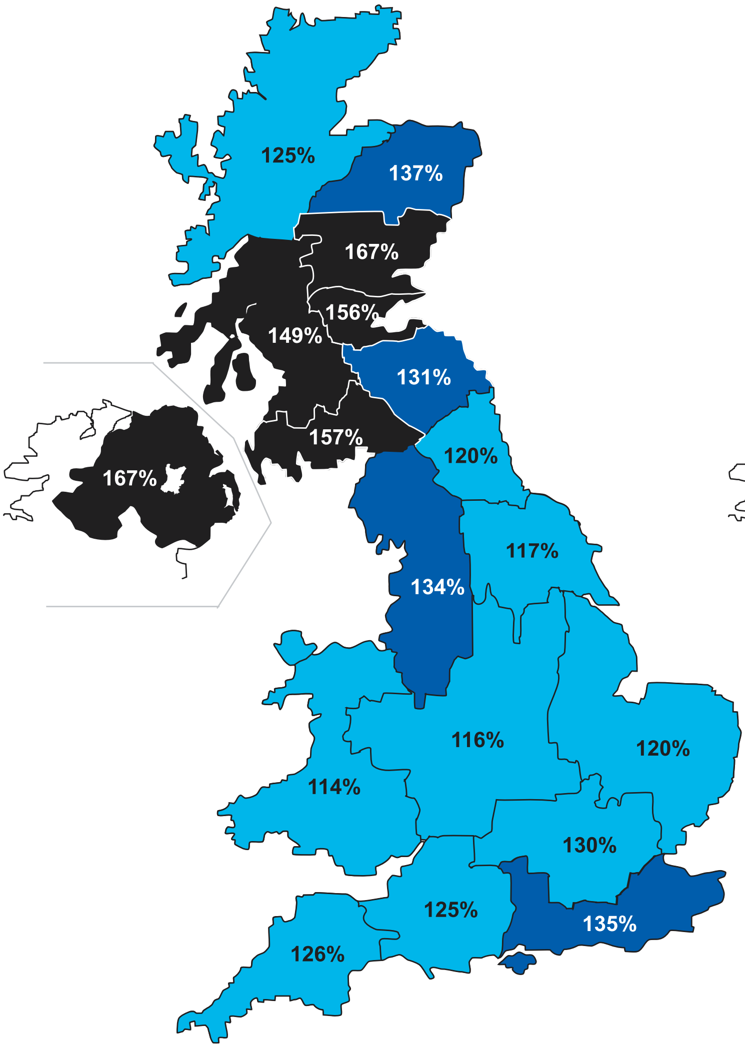
Above average

Normal range

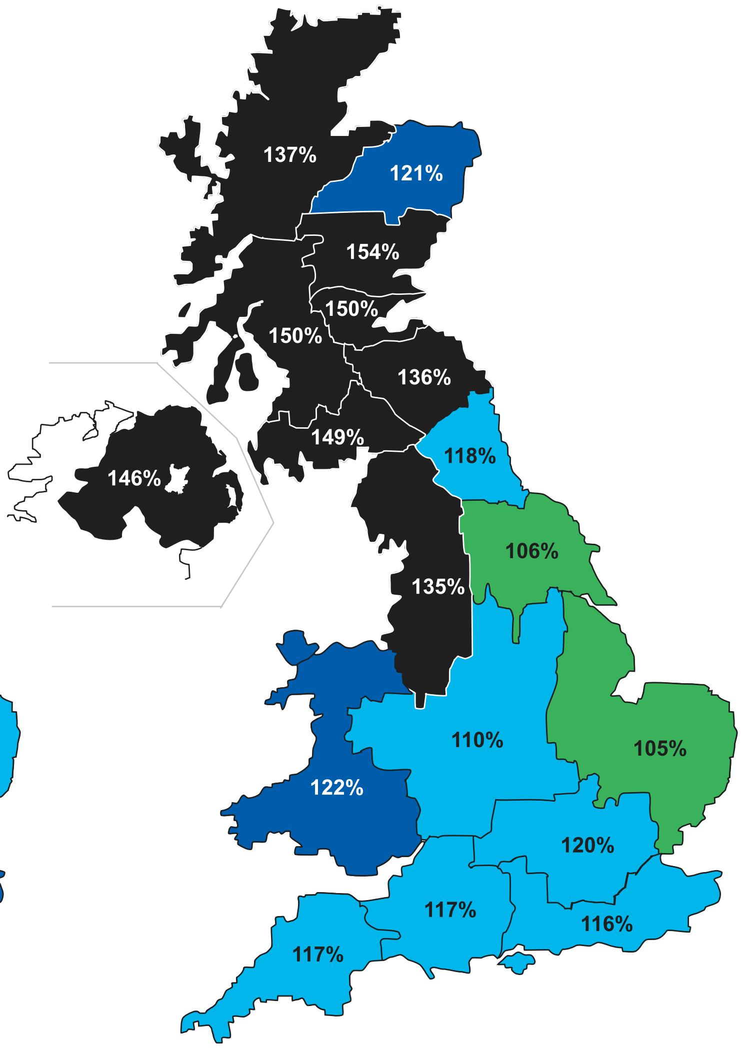
Below average

Substantially below average

Exceptionally low rainfall



May 2002 - July 2002

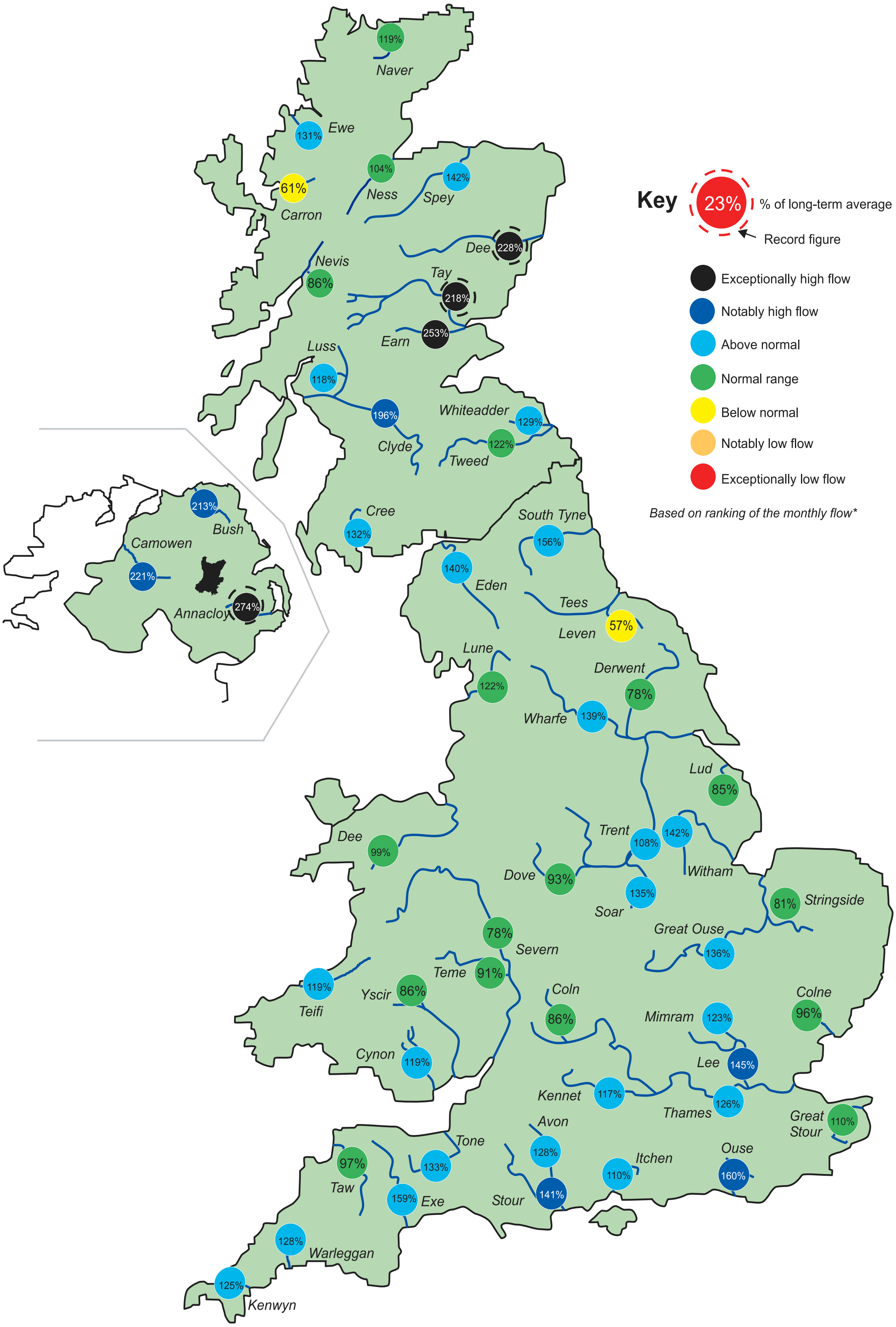


January 2002 - July 2002

Rainfall accumulation maps

Rainfall for the May-July period was well above average for all regions of the UK (but not all areas, the Northern Isles were relatively dry for example). Northern Ireland reported its highest (provisionally) May-July rainfall since 1958, and in parts of Scotland (e.g. the Tay basin) the three-month total was the highest for at least 50 years. In the January-July timeframe, a few eastern areas have received only average rainfall but most regions have been notably wet, parts of Scotland exceptionally so. Provisional figures suggest that the UK rainfall for 2002 thus far is the highest on record, in a series from 1900.

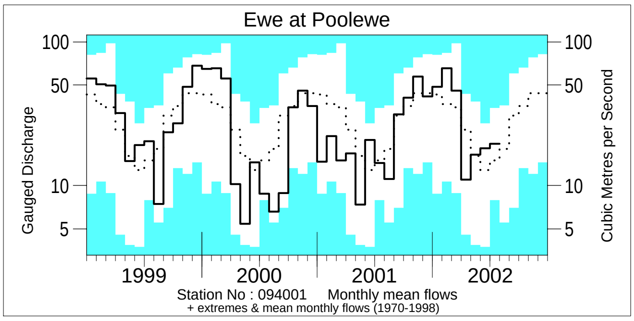
River flow . . . River flow . . .

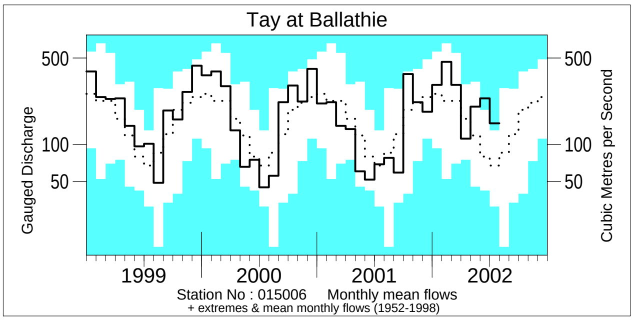


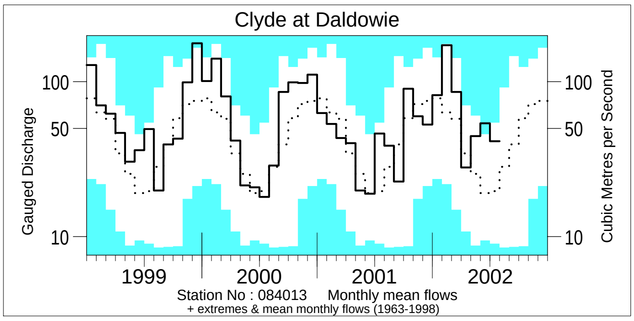
River flows - July 2002

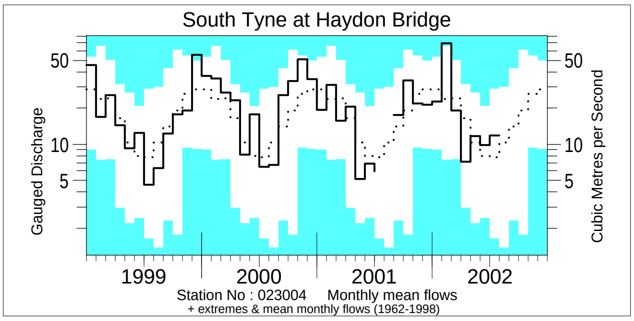
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

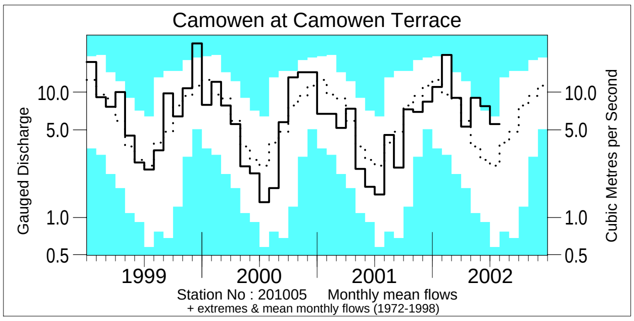
River flow . . . River flow . . .

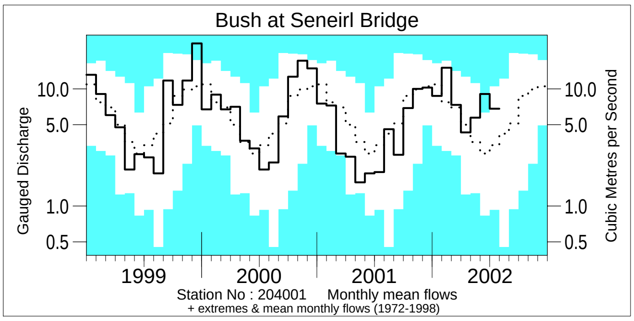


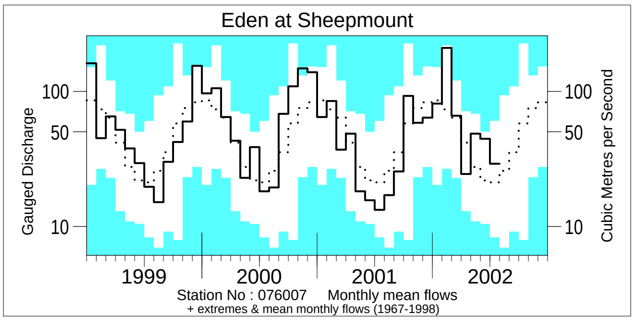


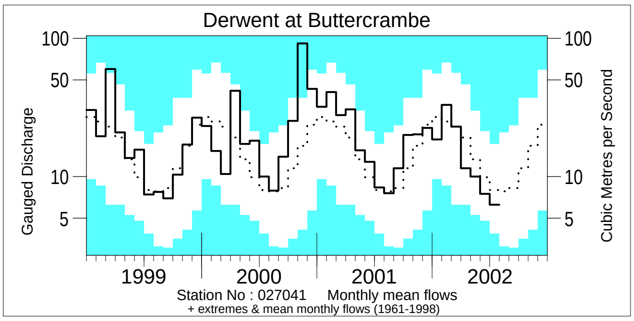


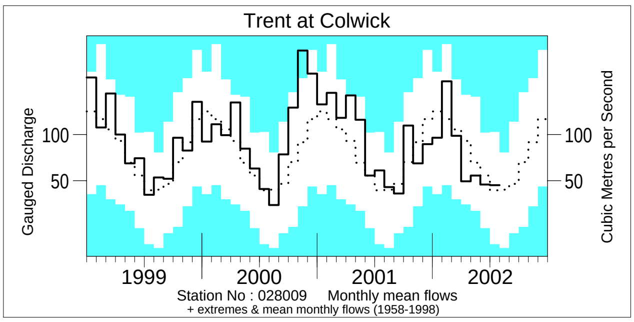


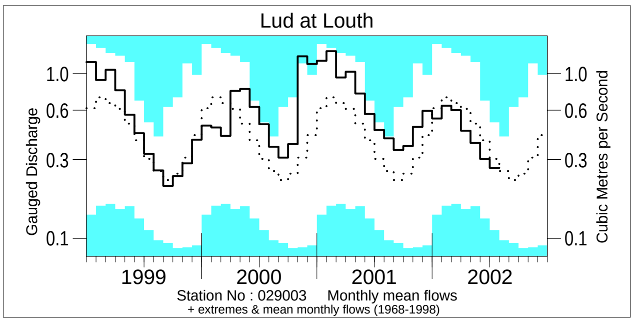








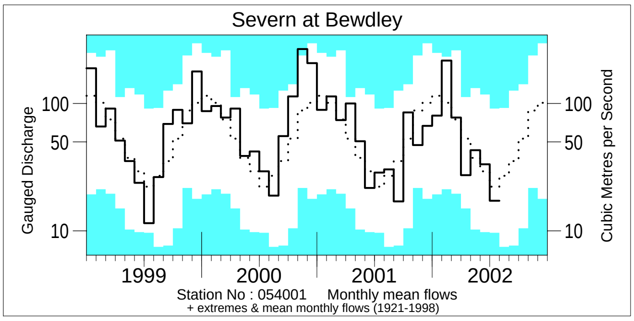


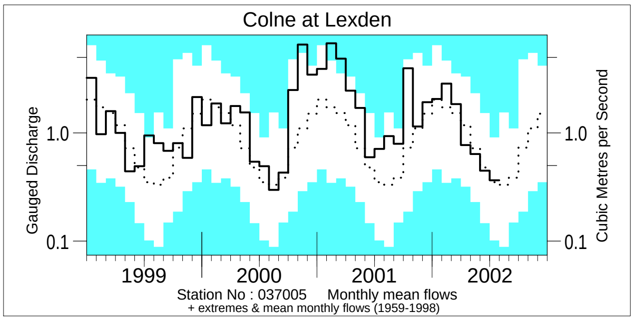


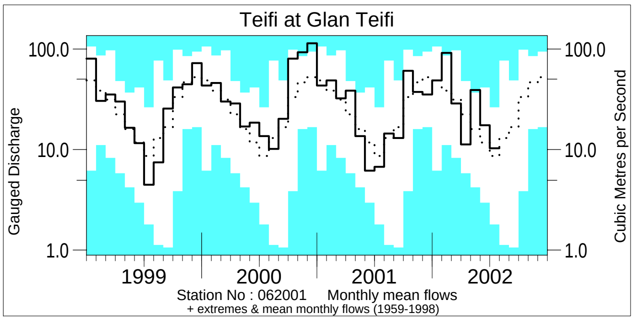
Monthly river flow hydrographs

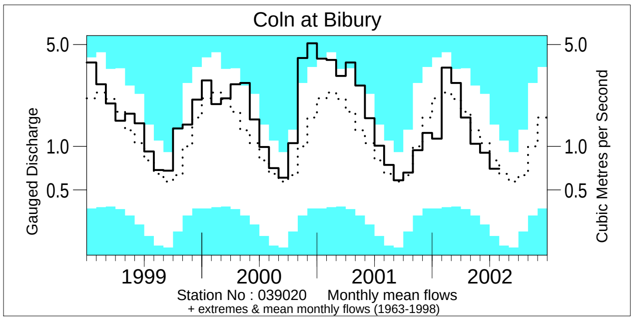
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1999 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded areas.

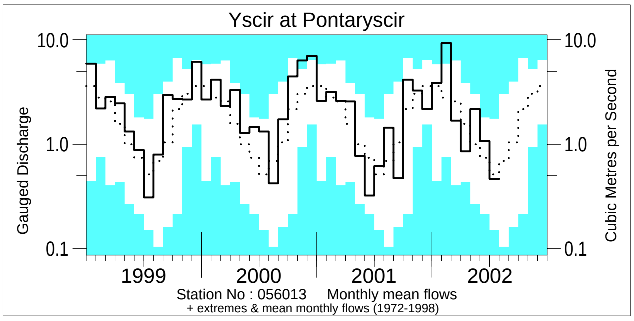
River flow . . . River flow . . .

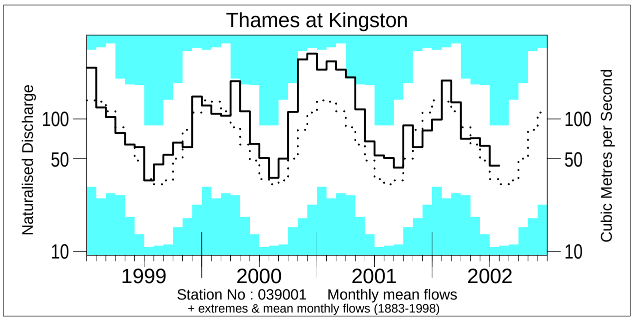


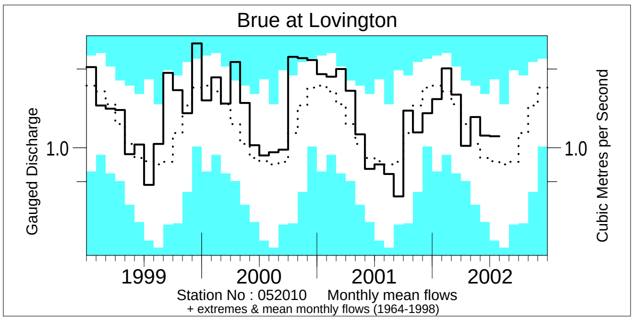


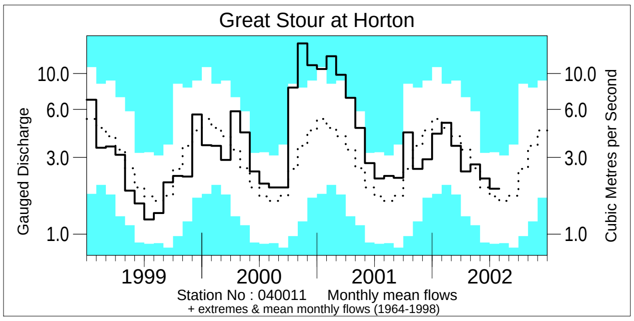


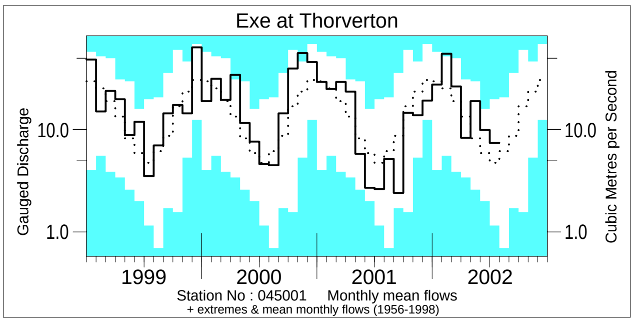


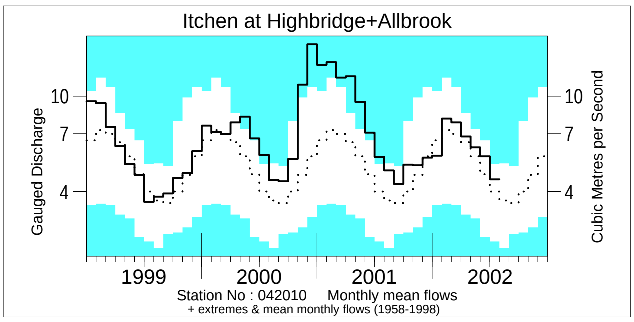












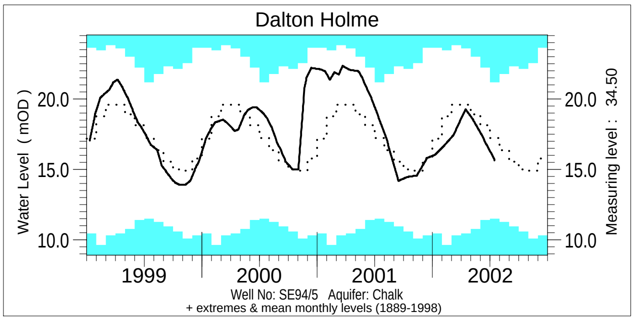
Notable runoff accumulations (a) May 2002 - July 2002, (b) January 2002 - July 2002

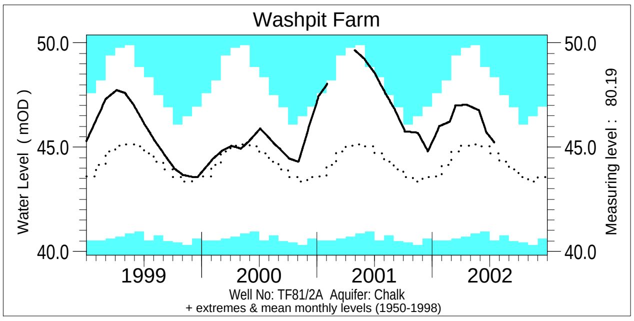
	River	%lta	Rank
a)	Tay	216	50/50
	Earn	261	55/55
	Leven (Clevland)	48	2/42
	Mole	229	29/29
	Cynon	190	44/44
	Nith	234	45/45
	Clyde	205	39/39
	Camowen	238	31/31

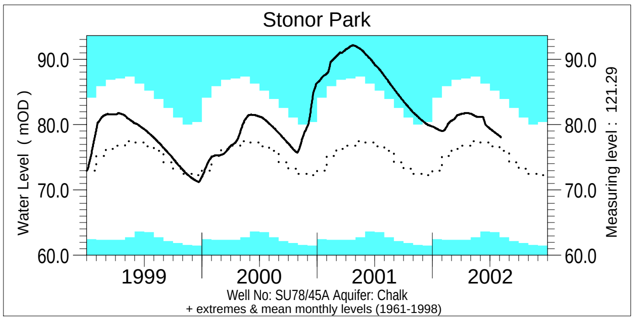
	River	%lta	Rank
b)	Ness	129	27/30
	Tweed	137	41/42
	Wharfe	131	46/47
	Exe	140	45/46
	Dart	146	44/44
	Taw	125	41/44
	Yscir	144	30/30
	Teifi	135	42/43
	Welsh Dee	138	33/33
	Lune	150	42/42
	Eden	144	35/35
	Cree	142	39/39
	Luss	138	24/24
	Bush	141	29/30

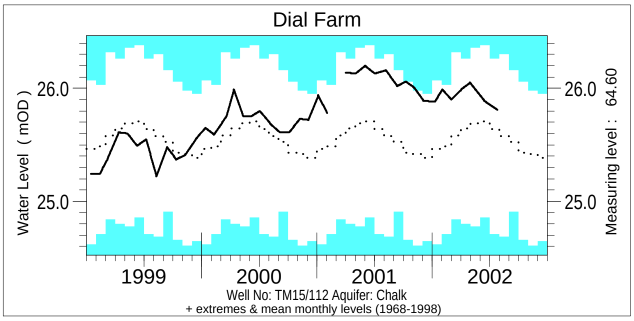
lta = long term average
Rank 1 = lowest on record

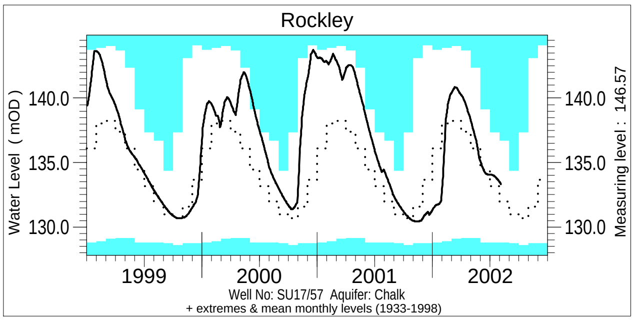
Groundwater . . . Groundwater

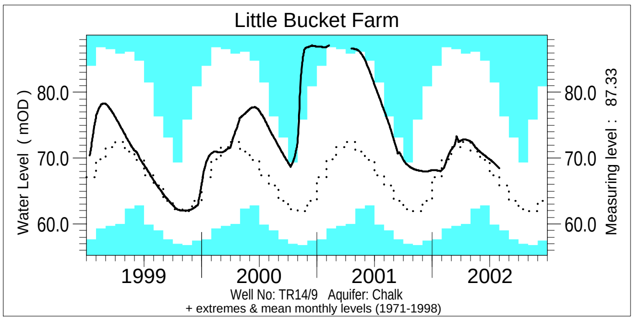


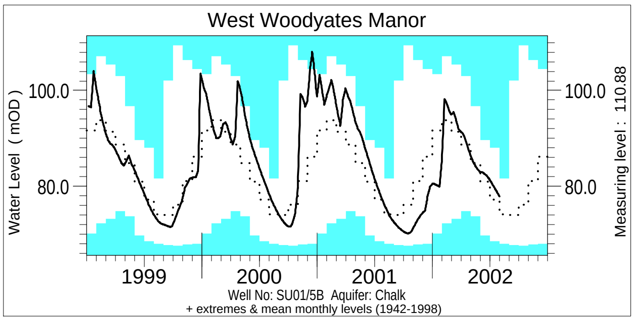


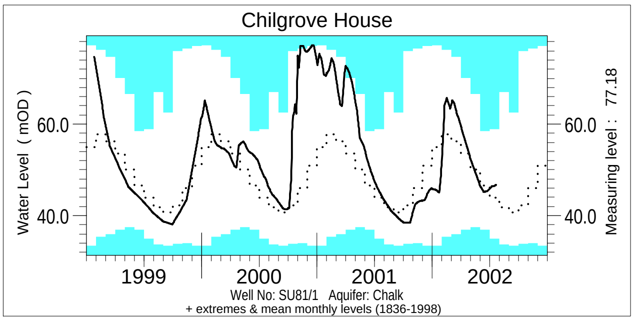


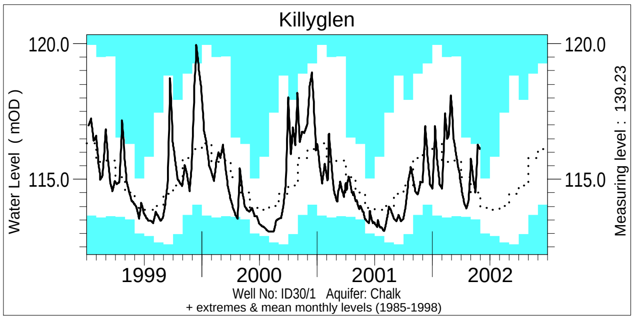


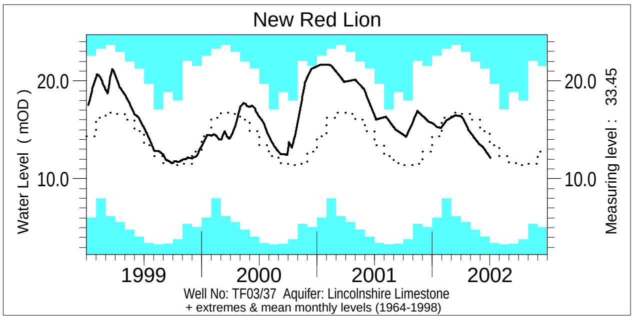






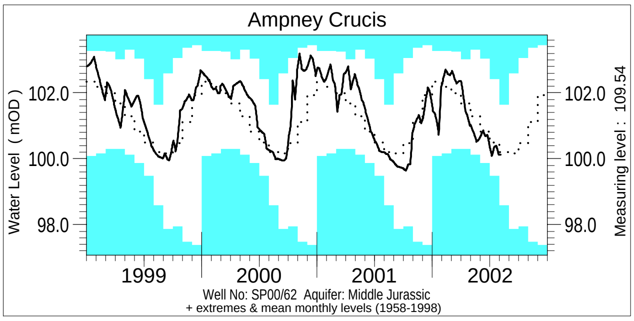


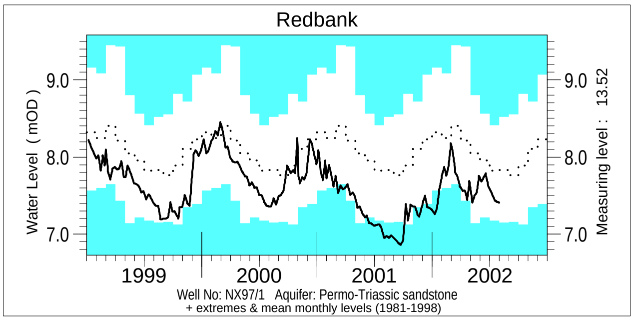


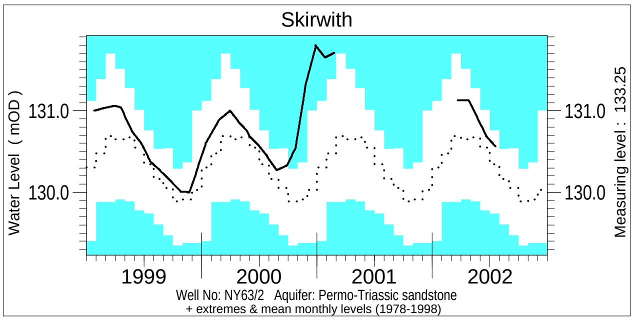


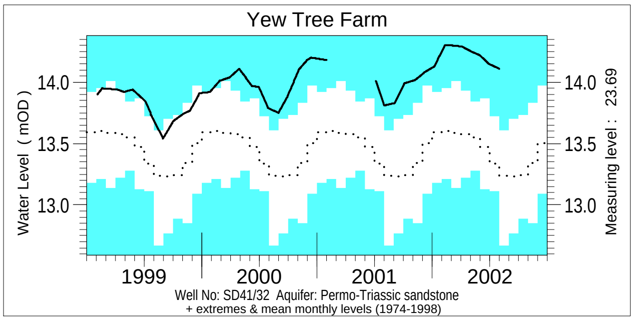
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

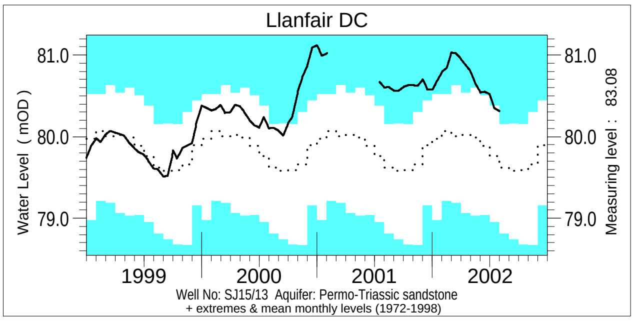
Groundwater . . . Groundwater

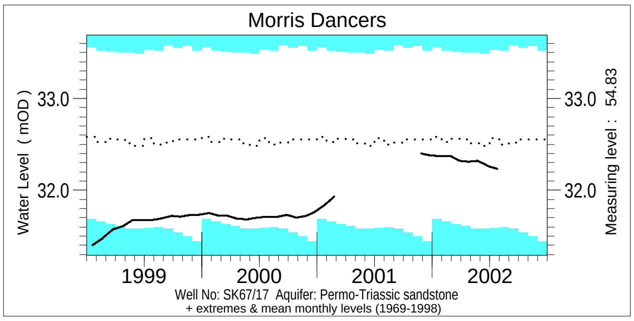


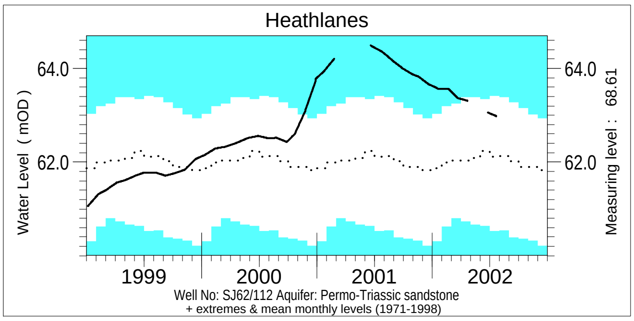


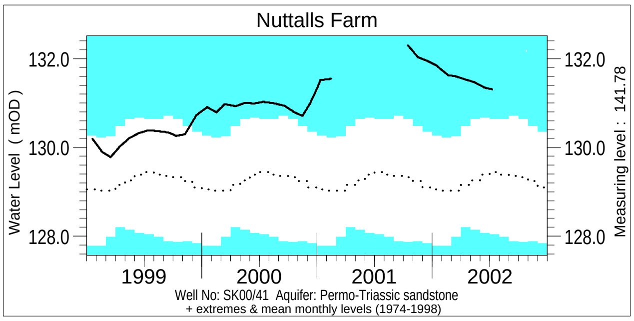


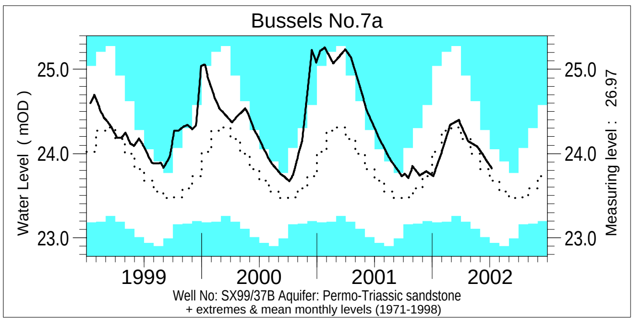


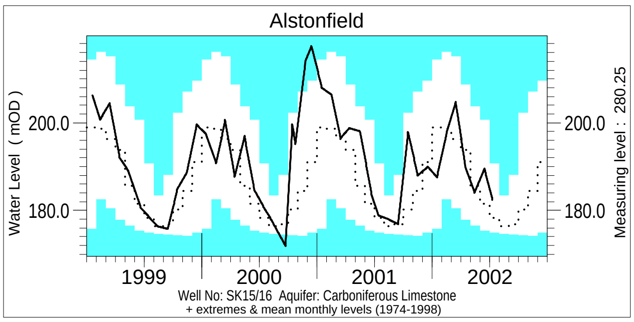












Groundwater levels July 2002 / August 2002

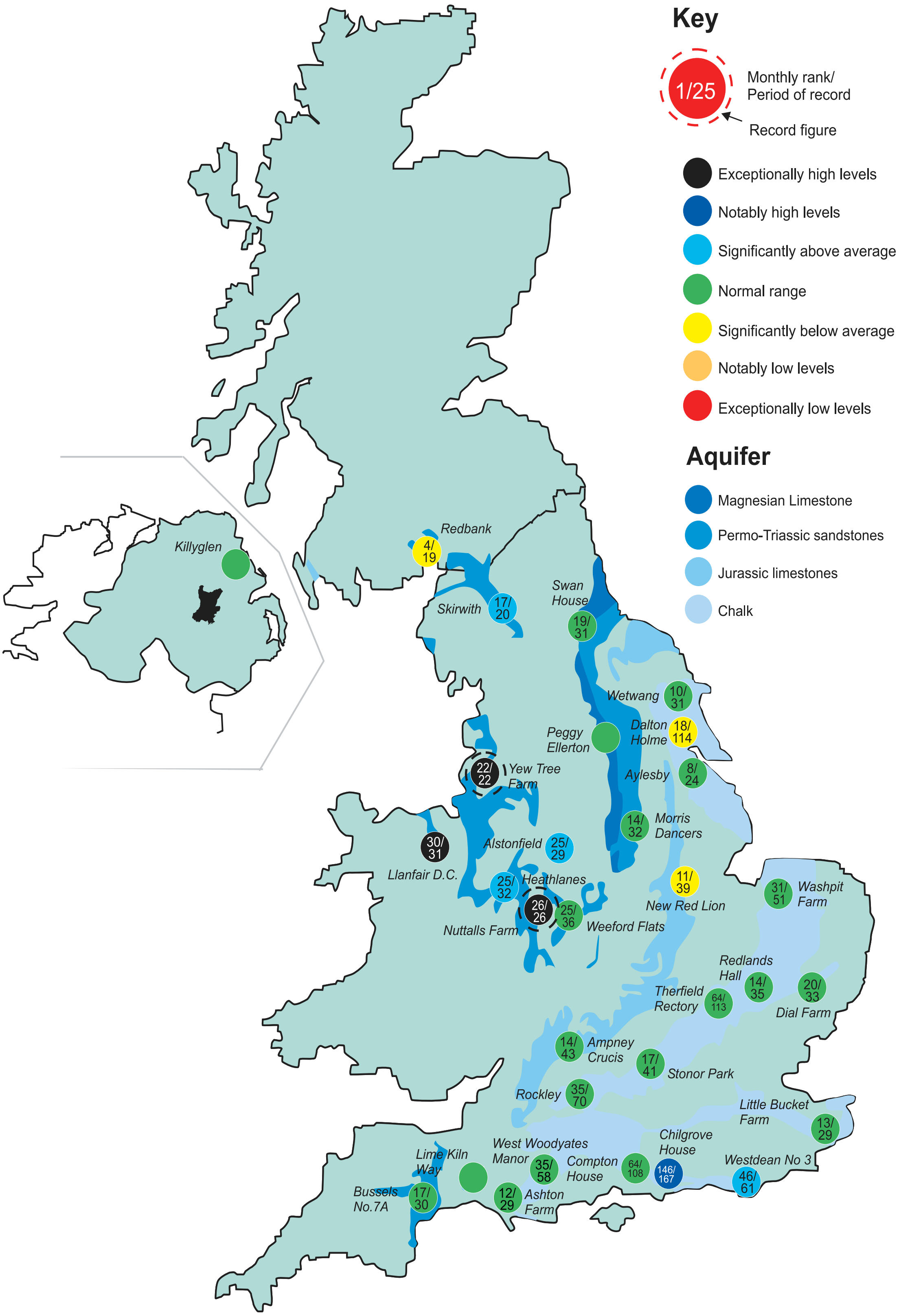
Borehole	Level	Date	Jul. av.
Dalton Holme	15.66	16/07	17.21
Washpit Farm	45.21	16/07	44.86
Stonor Park	78.08	05/08	77.63
Dial Farm	25.81	25/07	25.67
Rockley	133.31	05/08	133.22
Little Bucket Farm	68.44	31/07	68.90
West Woodyates	77.82	31/07	76.97

Borehole	Level	Date	Jul. av.
Chilgrove House	46.77	22/07	43.59
Killyglen	-	-	-
New Red Lion	12.10	04/07	13.44
Ampney Crucis	100.13	05/08	100.46
Redbank	7.41	31/07	7.78
Skirwith	130.56	19/07	130.28
Yew Tree Farm	14.11	31/07	13.21

Borehole	Level	Date	Jul. av.
Llanfair DC	80.31	01/08	79.71
Morris Dancers	32.23	26/07	32.37
Heathlanes	62.98	22/07	62.17
Nuttalls Farm	131.31	10/07	129.52
Bussels No.7a	23.82	08/07	23.73
Alstonfield	182.38	10/07	178.94

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



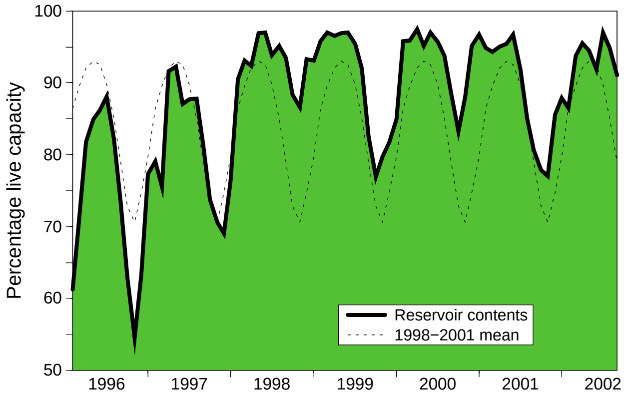
Groundwater levels - July 2002

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.

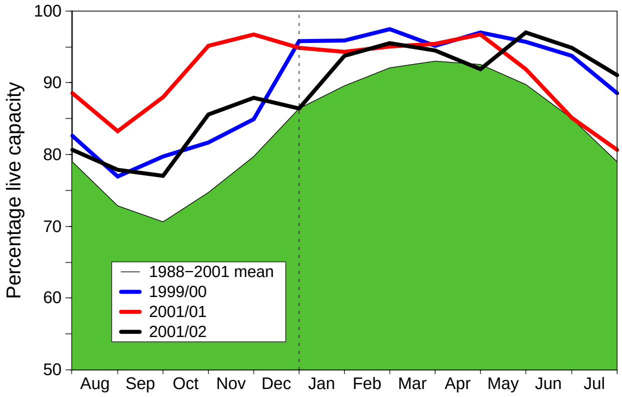
(Note: Redbank is affected by groundwater abstraction, recent levels at Killyglen are under review)

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.

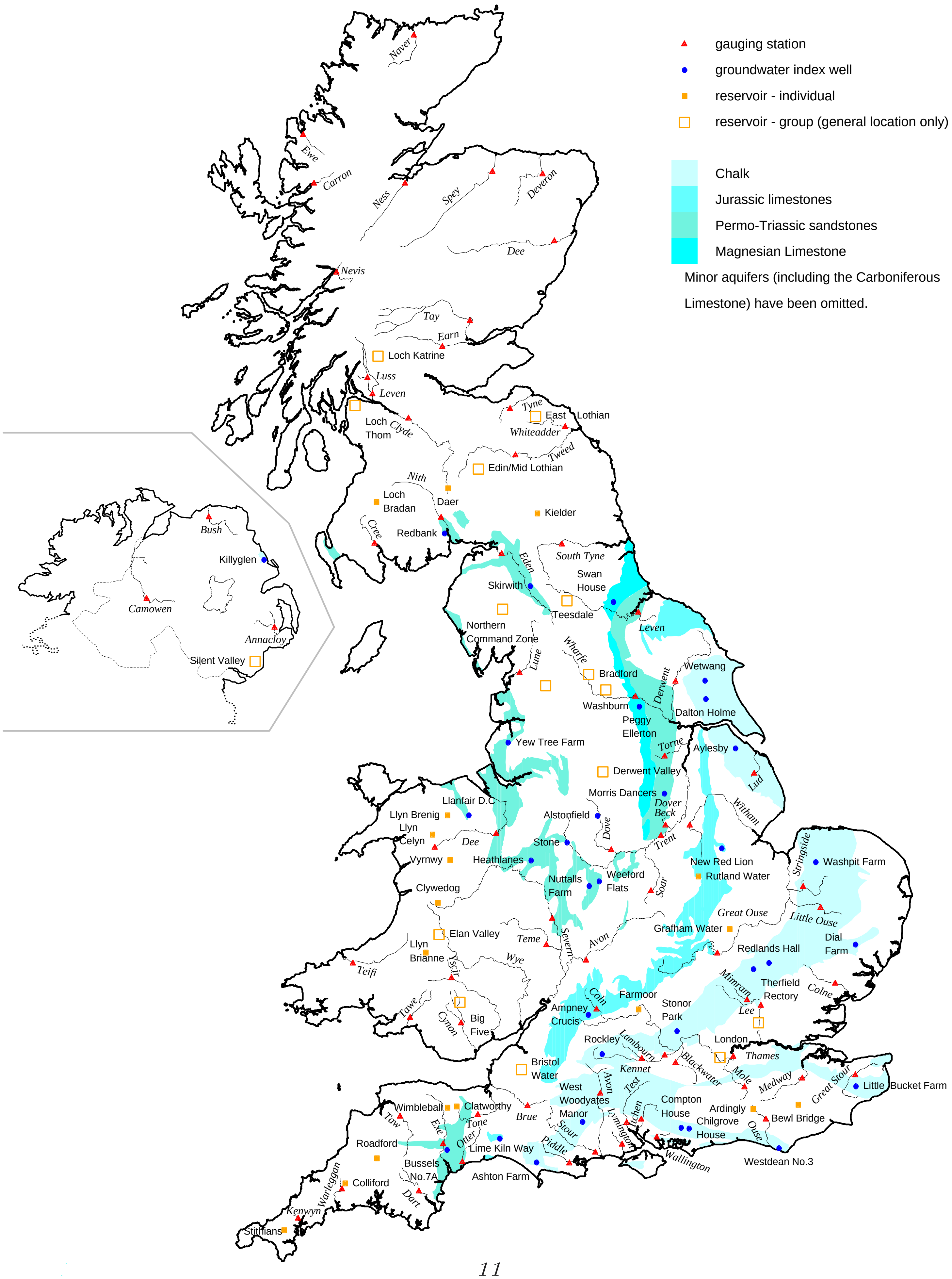
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2002 Mar	Apr	May	Jun	Jul	Aug	Min. Aug	Year* of min
North West	N Command Zone	•	124929	100	97	89	100	97	88	38	1989
	Vyrnwy		55146	100	100	94	99	95	90	56	1996
Northumbrian	Teesdale	•	87936	100	97	89	98	95	88	45	1989
	Kielder		(199175)	(96)	(92)	(91)	(98)	(94)	(90)	(66)	1989
Severn Trent	Clywedog		44922	100	94	98	99	98	92	57	1989
	Derwent Valley	•	39525	100	98	88	85	81	80	43	1996
Yorkshire	Washburn	•	22035	97	91	85	91	89	81	50	1995
	Bradford supply	•	41407	100	96	84	95	95	93	38	1995
Anglian	Grafham		(55490)	(87)	(89)	(91)	(94)	(96)	(95)	(66)	1997
	Rutland		(116580)	(89)	(92)	(94)	(95)	(92)	(90)	(74)	1995
Thames	London	•	202340	88	92	93	97	97	94	73	1990
	Farmoor	•	13830	88	87	95	90	96	95	84	1990
Southern	Bewl		28170	97	98	95	95	93	89	45	1990
	Ardingly		4685	100	100	100	100	99	99	66	1995
Wessex	Clatworthy		5364	100	100	89	100	97	91	43	1992
	Bristol WW	•	(38666)	(99)	(98)	(93)	(95)	(93)	(89)	(53)	1990
South West	Colliford		28540	78	82	81	84	84	80	47	1997
	Roadford		34500	94	94	91	94	93	97	46	1996
	Wimbleball		21320	100	100	97	100	97	94	53	1992
	Stithians		5205	78	88	85	86	83	76	39	1990
Welsh	Celyn and Brenig	•	131155	100	98	99	100	99	98	65	1989
	Brianne		62140	98	97	89	100	99	96	67	1995
	Big Five	•	69762	97	94	90	98	94	89	41	1989
	Elan Valley	•	99106	100	97	93	100	95	90	63	1989
East of Scotland	Edinburgh/Mid Lothian	•	97639	100	98	94	99	100	94	51	1998
	East Lothian	•	10206	100	100	100	96	98	89	72	1992
West of Scotland	Loch Katrine	•	111363	100	99	95	100	99	96	53	2000
	Daer		22412	100	100	99	100	99	99	58	1994
	Loch Thom	•	11840	100	98	95	100	100	95	59	2000
Northern Ireland	Silent Valley	•	20634	57	59	65	81	90	81	42	2000

() figures in parentheses relate to gross storage • denotes reservoir groups * 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 1988-2002 period only (except for West of Scotland and Northern Ireland where data commence in 1994 and 1993 respectively). 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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7/02