Hydrological summary

for the United Kingdom

August 2000

General

Despite an unsettled complexion to the weather during August it was, overall, a sunny and relatively dry month in most regions. Rainfall totals for the summer (June-August) were also generally below average. Nonetheless, reservoir contents – although declining briskly in August – remain well above the seasonal average in most regions; entering the autumn, overall stocks for England and Wales are at their second highest since 1988. Thunderstorms triggered some localised flooding but monthly runoff totals were mostly below average, albeit well within the normal range. Groundwater levels (where abstraction is not a significant influence) are close to or above average in most major aquifer units. The coupling of a relatively dry summer and a relatively wet preceding winter has been a recurring feature of the recent past. So also has the development of above average early autumn soil moisture deficits in the lowlands - these may delay the onset of the seasonal recovery in runoff and recharge rates.

Rainfall

Media attention in August was largely directed to unusual (and isolated) meteorological phenomena (e.g. tornadoes, drifts of hail, falls of fish even). Some notable rainfall events were reported (e.g. 45 mm in about an hour at Knaphill, Surrey on the 28th, and 54 mm in an hour in the Forest of Bowland on the 21st, the latter having a return period well in excess of 100 years). Those localities which bore the brunt of the thundery activity reported high August rainfall totals (e.g. Aldegrove, in Northern Ireland recorded its second wettest August since 1943). However, the showery nature of much of the rainfall made for large local variations and many catchments reported modest monthly rainfalls. Parts of southern England were especially dry – Eastbourne reported only a quarter of the August average. English regional totals exhibited considerable spatial coherence with most in the 70-100% range. Summer (June-August) totals were appreciably below average in most regions; E & W registered its driest summer since 1996 and provisional data indicate that Scotland and NI both experienced their third driest summer since 1984. Accumulated rainfall deficiencies increased in parts of the Western Isles – where they are notable in the April-August timespan. Nonetheless, regional rainfall totals for the year thus far, and over the last 12 months, remain close to or above average throughout most of the UK.

River flow

As is typical of August, river flows were generally in decline in the English lowlands but modest recoveries were reported for many western and northern rivers (often following depressed flows in late July). Local flooding (e.g. in North Wales), mostly associated with thunderstorms, was common on the 21st - in Hull and Pwllheli flooding followed the rapid melting of substantial hail drifts. More widespread flooding occurred in the Borders Region on the 28th; after intense rainfall (77.8 mm in six hours at Abbey St. Bathans) river levels rose remarkably quickly, several landslides were triggered and the previous maximum August flow on the Eye Water was eclipsed. Although inter-catchment variations were large, August runoff totals were mostly well within the normal range throughout the UK, but again were very modest in parts of north-west Scotland (the third lowest in a 30- year record for the River Ewe). In southern England geology was especially influential. Whilst low rainfall was reflected in modest flows (albeit well above drought minima) in rivers draining impermeable catchments, the late onset of the seasonal recession has helped keep flows in spring-fed rivers above average despite summer rainfall of less than 80% in some catchments. Thus, the responsive Lymington and Wallington rivers in Hampshire recorded only around half the August average flow whilst the adjacent Test (a Chalk river) registered its highest August flow since 1971. Summer runoff totals in rivers largely dependent on baseflow were healthy, but in Scotland most June-August totals were below average. Longer term runoff accumulations are generally very healthy – a number of new September-August runoff maxima have been established (e.g. on the Welsh Dee and the Clyde); but in NI the Annacloy is an important exception – registering its lowest January-August total on record.

Groundwater

The first half of the year saw substantial but erratic recharge to most major aquifers - continuing into the late spring in many areas. Most summer recessions in the Chalk commenced from very healthy June levels and despite steep declines in August, remain close to, or above, the seasonal average – notably so in some eastern boreholes, e.g. at Aylesby. However in NI - where recharge this year has been modest – levels at Killyglen are low. After a period of erratic hydrograph behaviour, August groundwater levels in most limestone outcrop areas were also a little above the average – this is true of most minor aquifers in southern Britain also (e.g. in the Norfolk Drift and Essex Gravels). Generalisations can be less readily applied to levels in the Permo-Triassic sandstones (where abstraction rates and response times can be very influential). Levels are at record highs (for August) at Yew Tree Farm and Nuttall's Farm but are still very depressed at the slow responding Morris Dancers (in the Sherwood Sandstone).

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Rainfall accumulations and return period estimates

Area	Rainfall	Aug 2000	Jun 00-Aug 00	RP	Mar 00-Aug 00	RP	Jan 00-Aug 00	RP	Sep 99-Aug 00	RP
England & Wales	**mm**	**64**	**171**		**414**		**555**		**962**	
	%	**85**	**84**	**2-5**	**104**	**2-5**	**101**	**2-5**	**107**	**2-5**
North West	mm	101	281		527		763		1317	
	%	94	103	2-5	103	2-5	107	2-5	109	2-5
Northumbrian	mm	68	198		430		571		914	
	%	84	96	2-5	109	2-5	106	2-5	107	2-5
Severn Trent	mm	55	151		379		486		837	
	%	82	84	2-5	107	2-5	102	2-5	111	2-5
Yorkshire	mm	51	184		427		532		849	
	%	69	95	2-5	112	2-5	103	2-5	103	2-5
Anglian	mm	45	118		320		393		636	
	%	81	76	5-10	108	2-5	103	2-5	107	2-5
Thames	mm	47	116		354		450		752	
	%	82	71	5-10	109	2-5	104	2-5	109	2-5
Southern	mm	42	114		376		480		845	
	%	74	72	5-10	114	2-5	104	2-5	108	2-5
Wessex	mm	60	139		410		535		941	
	%	91	80	2-5	114	2-5	105	2-5	112	2-5
South West	mm	73	175		452		638		1154	
	%	87	79	2-5	98	2-5	91	2-5	98	2-5
Welsh	mm	103	257		562		822		1490	
	%	102	100	<2	107	2-5	107	2-5	113	5-10
Scotland	**mm**	**111**	**233**		**513**		**892**		**1626**	
	%	**95**	**79**	**5-10**	**88**	**2-5**	**107**	**2-5**	**113**	**5-10**
Highland	mm	106	237		595		1140		2072	
	%	83	72	5-15	88	2-5	115	5-10	118	10-20
North East	mm	97	179		457		636		1125	
	%	111	79	5-10	106	2-5	106	2-5	116	5-15
Tay	mm	106	228		481		800		1457	
	%	113	94	2-5	97	2-5	109	2-5	119	10-15
Forth	mm	106	237		475		747		1288	
	%	113	100	<2	102	2-5	113	5-10	116	5-15
Tweed	mm	117	240		472		655		1074	
	%	133	106	2-5	109	2-5	109	2-5	111	2-5
Solway	mm	141	290		551		879		1551	
	%	118	99	2-5	96	2-5	106	2-5	109	2-5
Clyde	mm	131	281		555		1013		1895	
	%	98	84	2-5	84	5-10	105	2-5	112	5-10
Northern Ireland	**mm**	**98**	**194**		**408**		**575**		**1144**	
	%	**108**	**85**	**2-5**	**90**	**2-5**	**90**	**2-5**	**108**	**2-5**

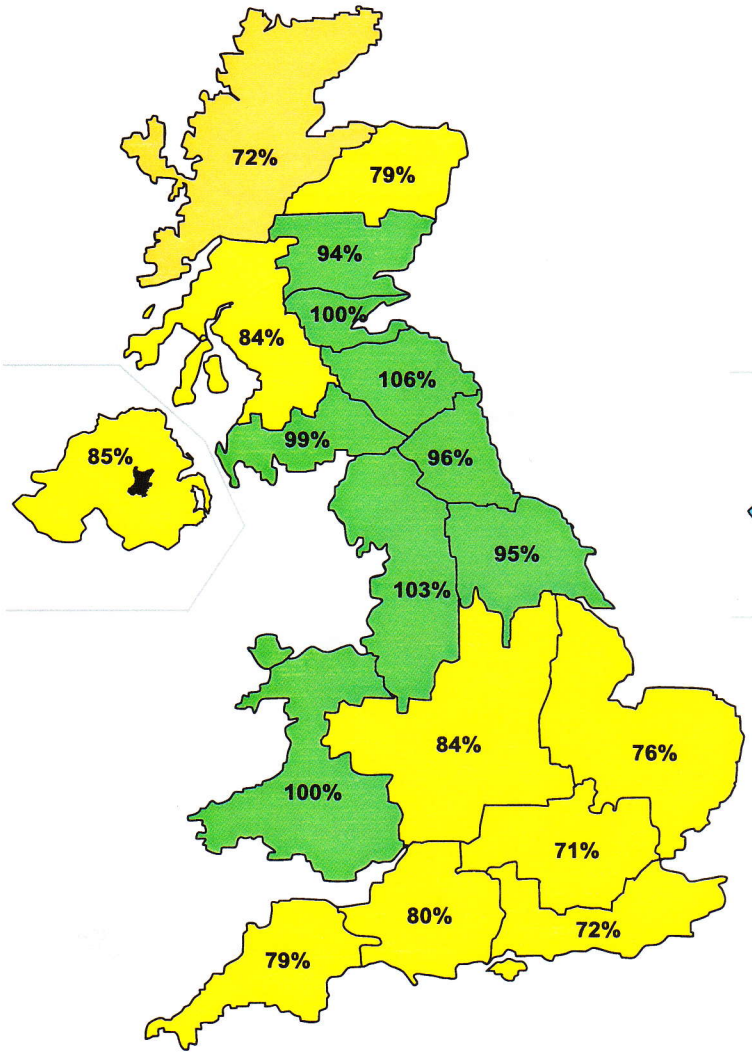
RP = Return period

 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.

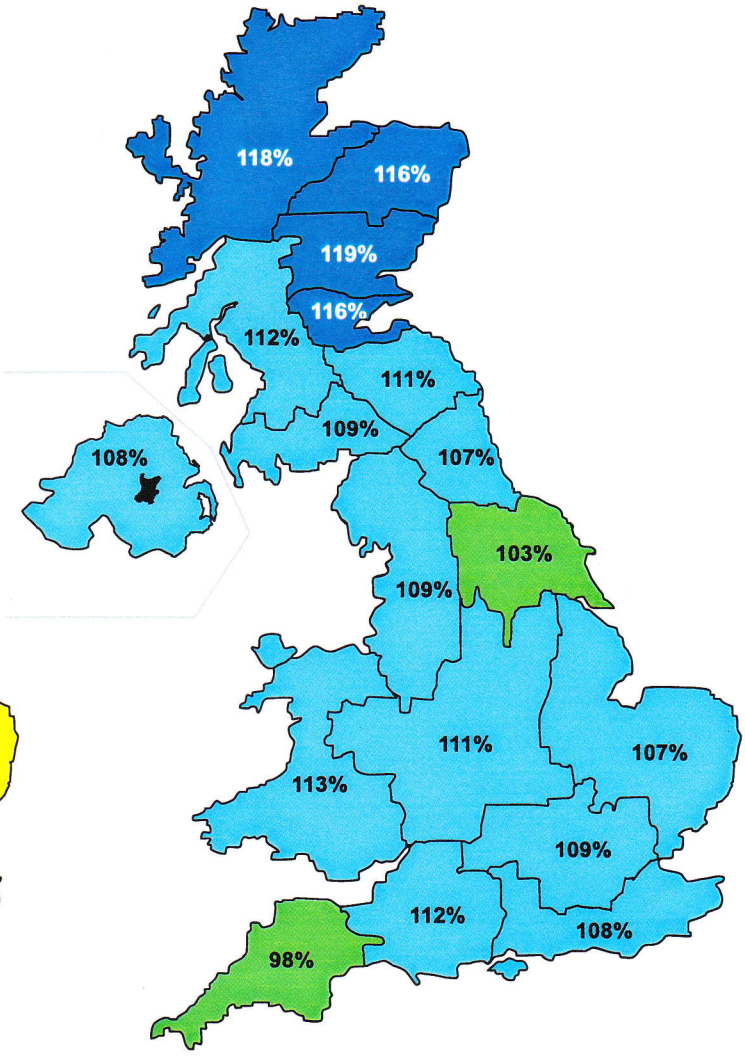
Rainfall . . . Rainfall . . . Rainfall

Key

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



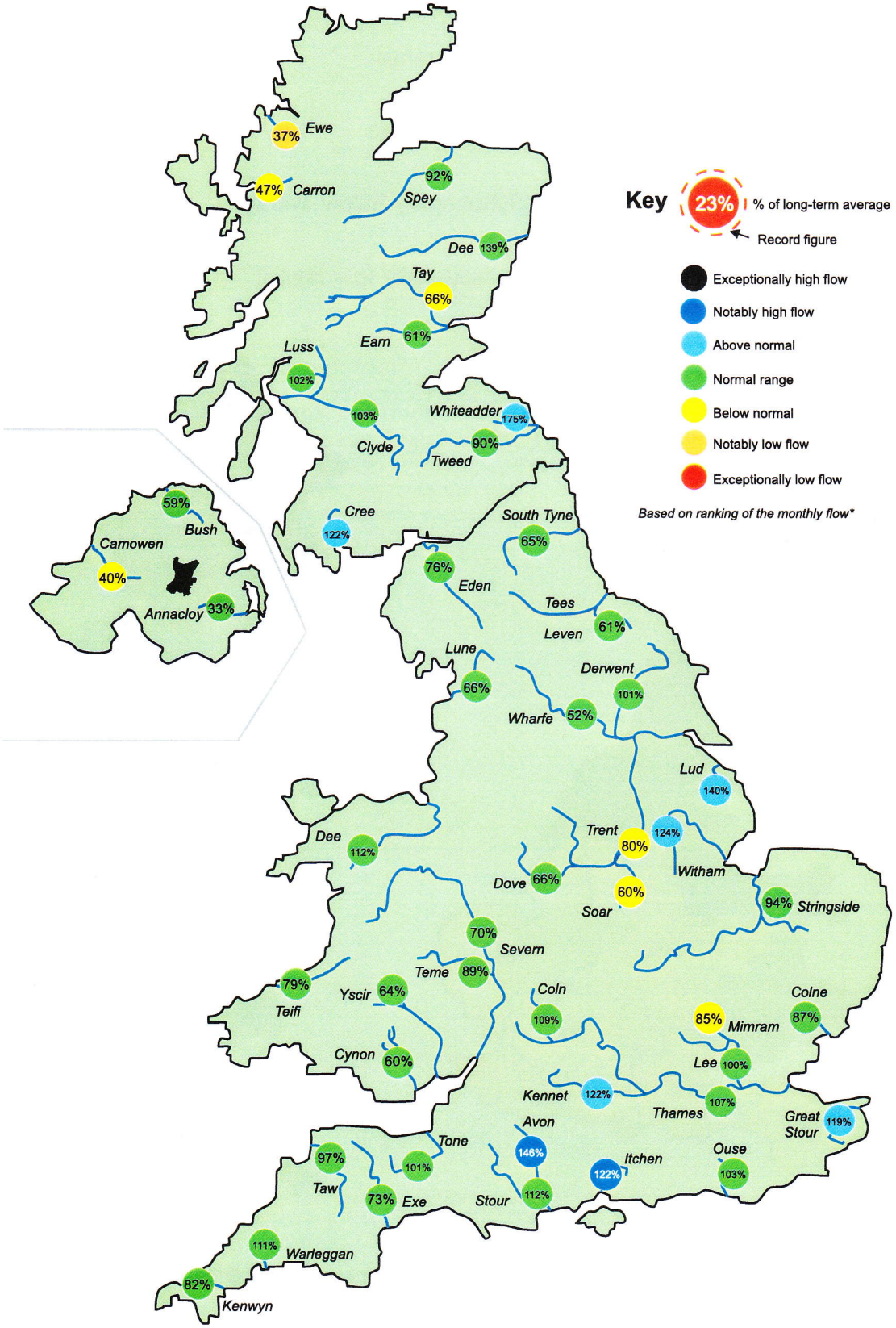
June 2000 - August 2000



September 1999 - August 2000

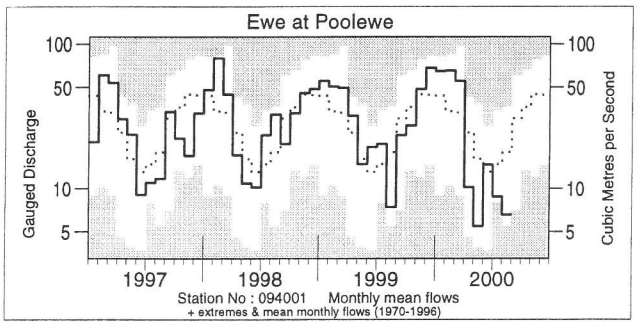
Rainfall accumulation maps

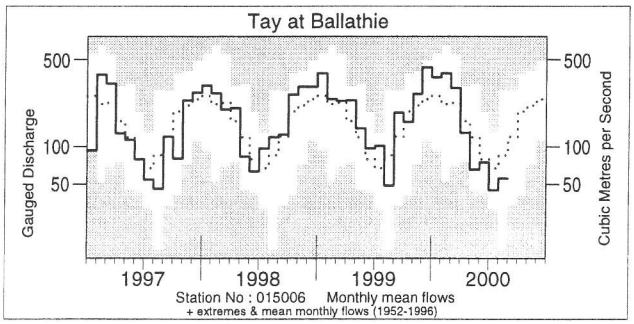
The provisional UK summer rainfall total is around 82% of the 61-90 average and ranks the 16th in a series from 1900. By contrast the September-August total is the 15th highest (but 1998/99 was substantially wetter). Notwithstanding the dry summer, the September-August total for Scotland is the 9th highest in a record from 1869. Seven of the 10 highest September-August totals now cluster in the post 1987 period.

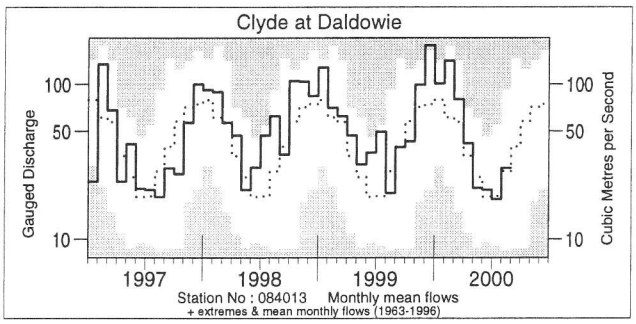


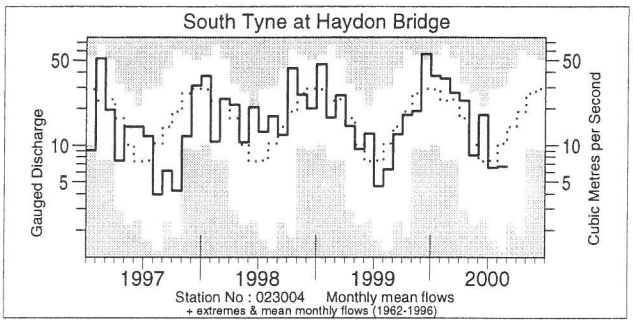
River flows - August 2000

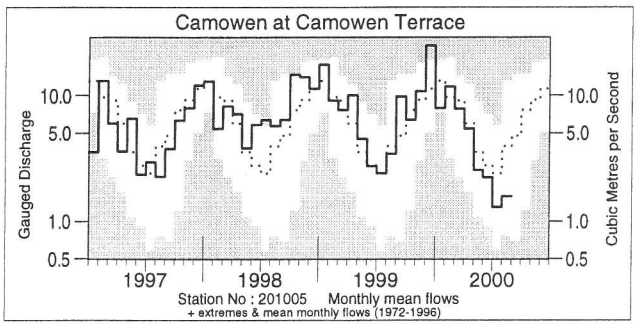
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

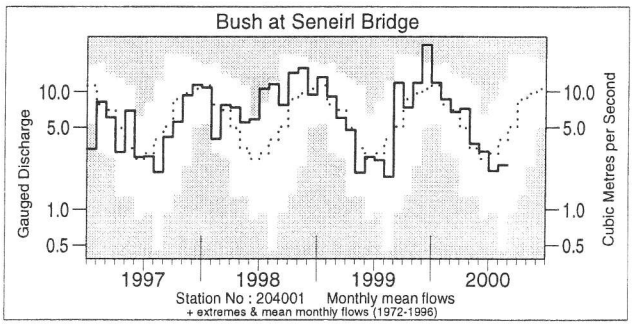


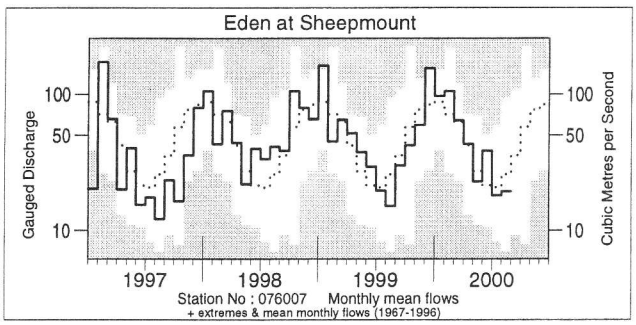


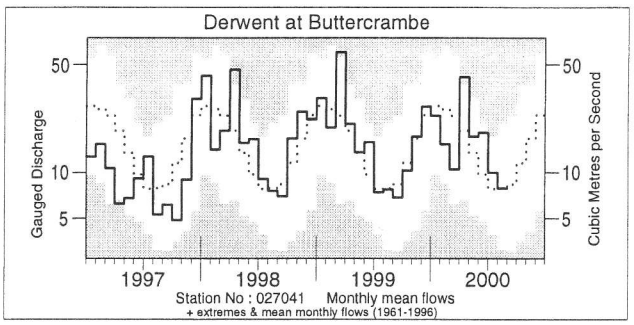


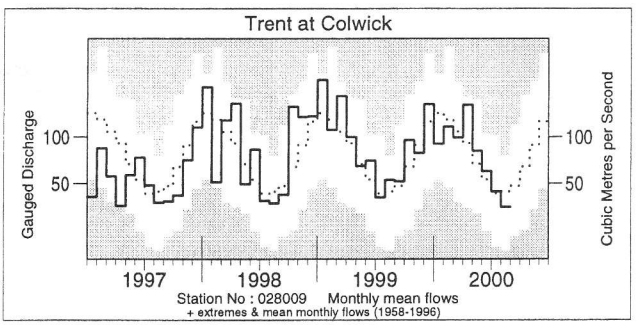


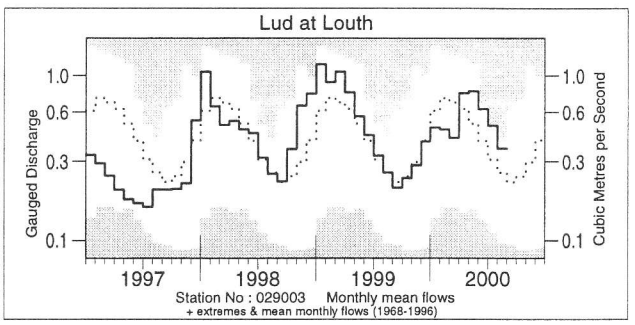








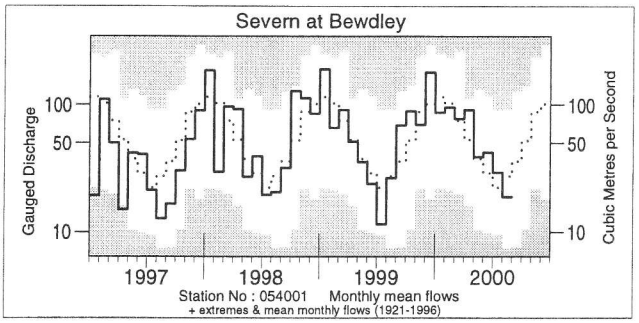


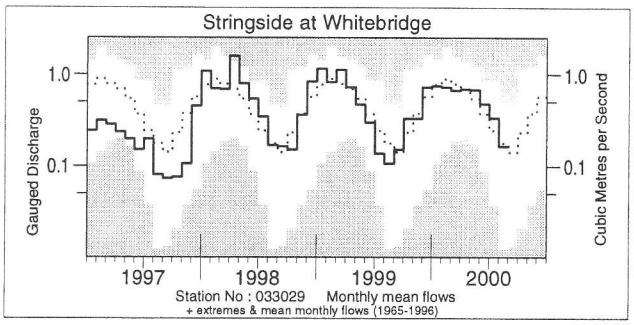


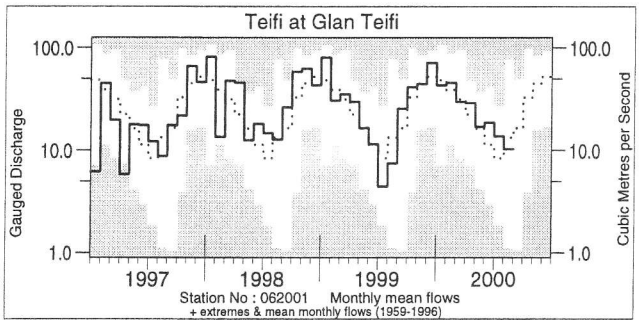
Monthly river flow hydrographs

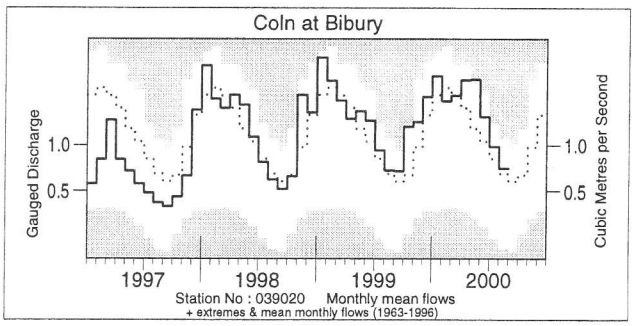
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1997 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

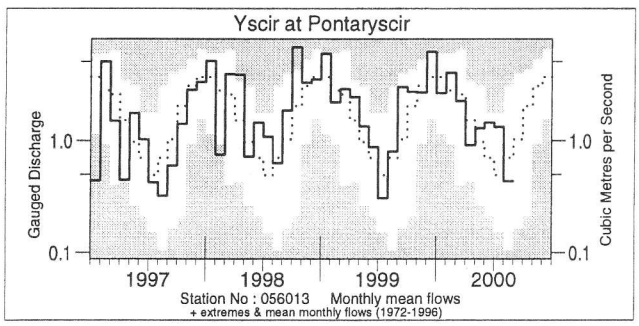
River flow . . . River flow . . .

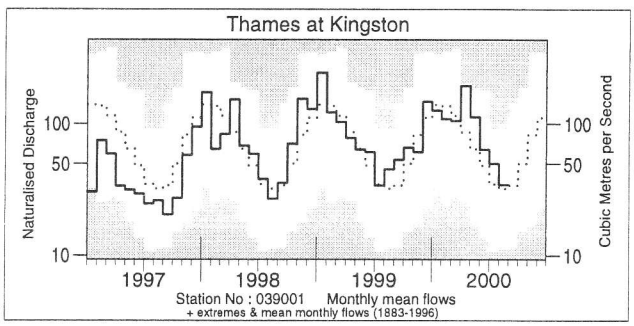


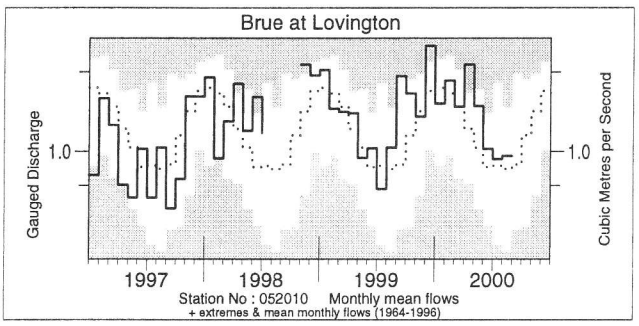


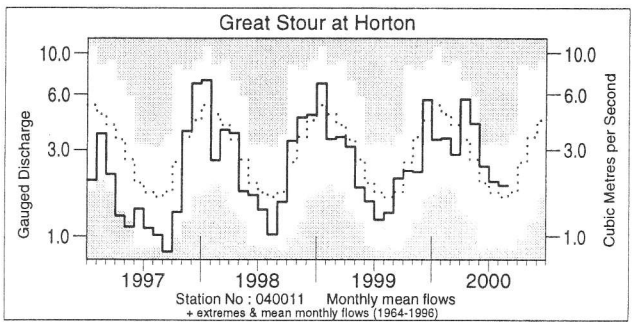


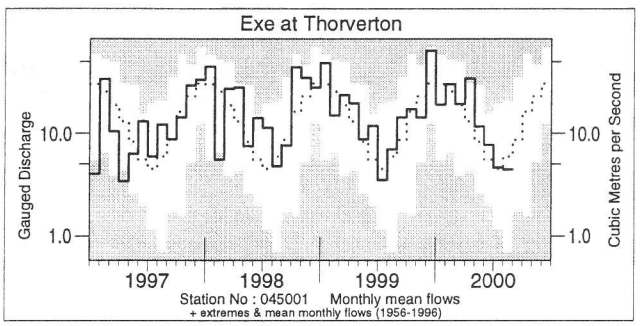


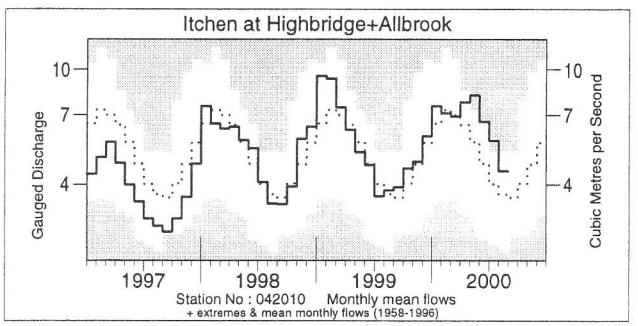










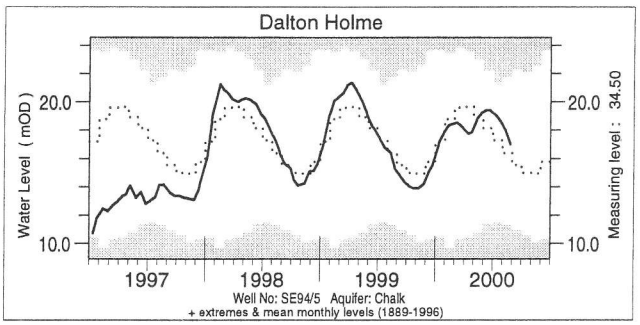


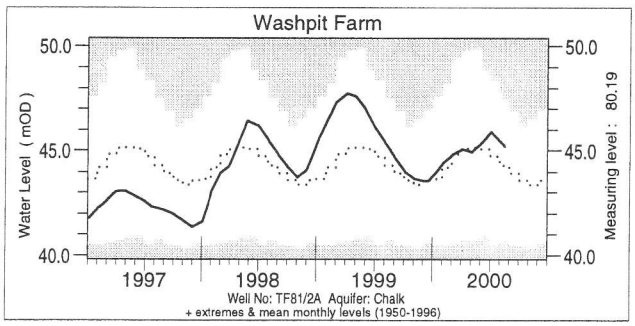
Notable runoff accumulations June - August 2000 (a); April 2000 - August 2000 (b); September 1999 - August 2000(c)

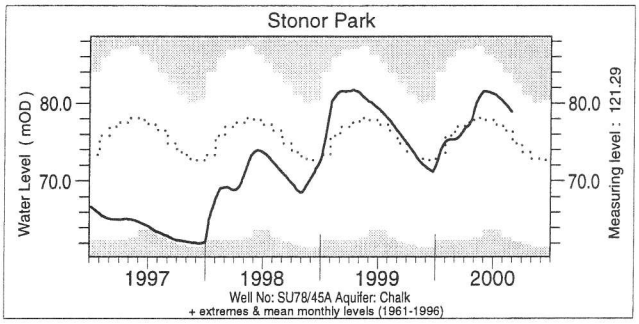
River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
(a) Leven	164	37/40	(b) Kennet	160	39/39	(c) Coln	131	35/36
Lud	154	28/32	Teme	186	31/31	Dee	161	31/31
Test	143	42/42	Carron	64	1/22	Clyde	139	36/36
Avon	159	36/36	Ewe	53	1/30	Annacloy	78	2/20

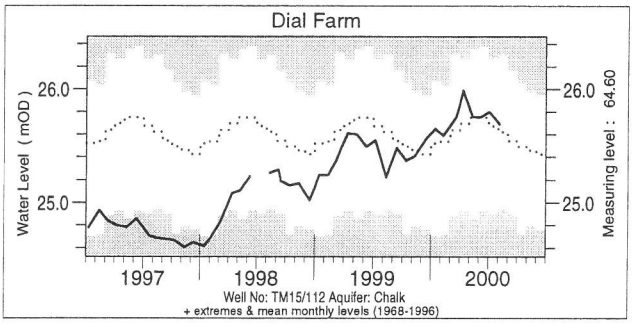
lta = long term average
Rank 1 = lowest on record

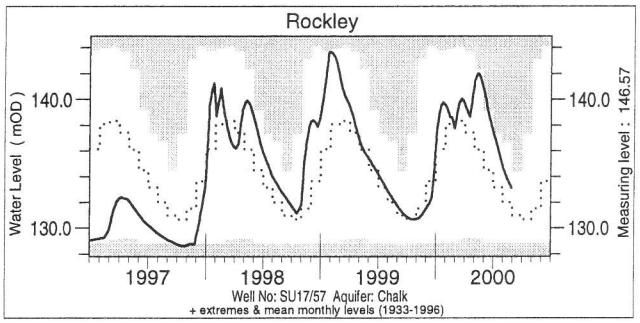
Groundwater . . . Groundwater

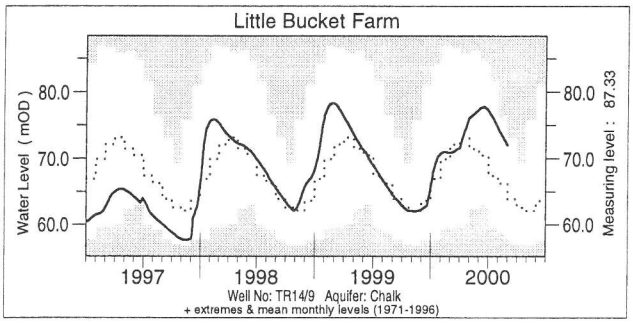


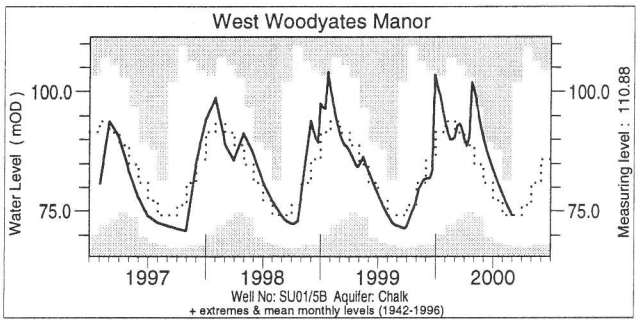


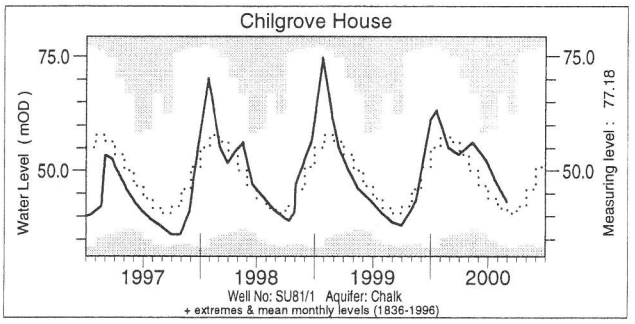


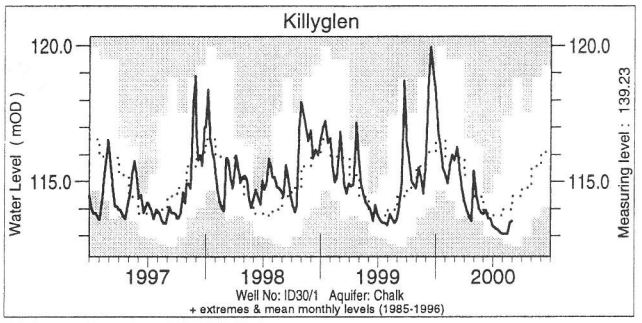


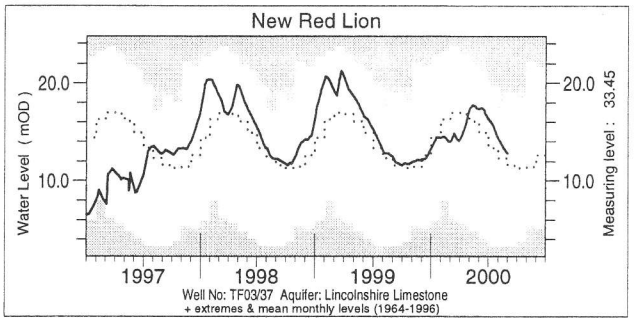








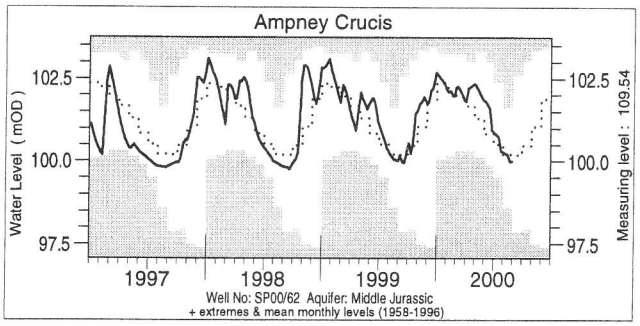


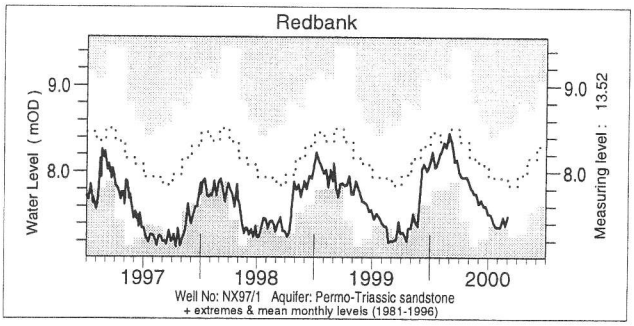


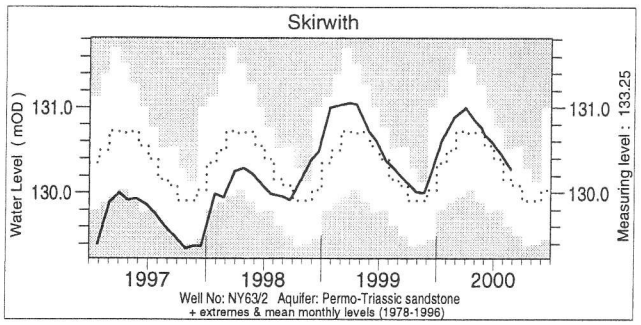
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

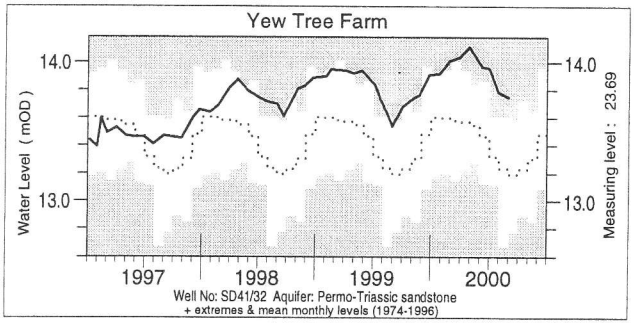
Note. Due to the impact of abstraction on groundwater levels at The Holt borehole, it has been replaced as an index site by the Stonor Park well.

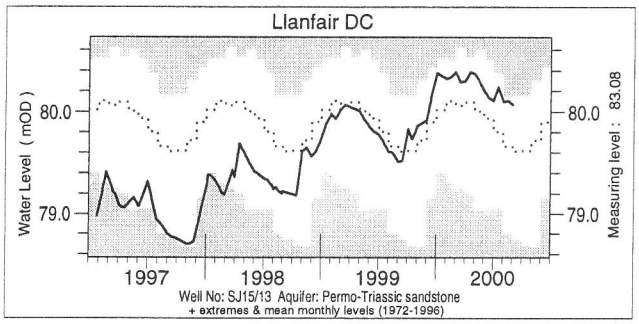
Groundwater . . . Groundwater

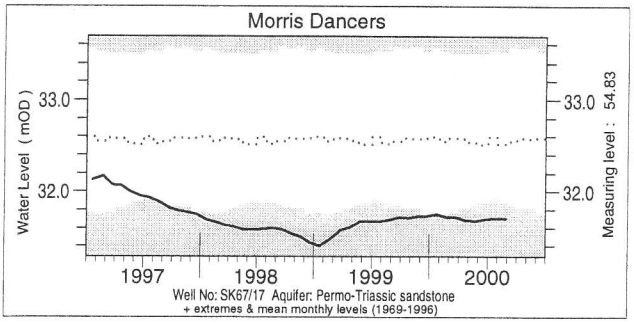


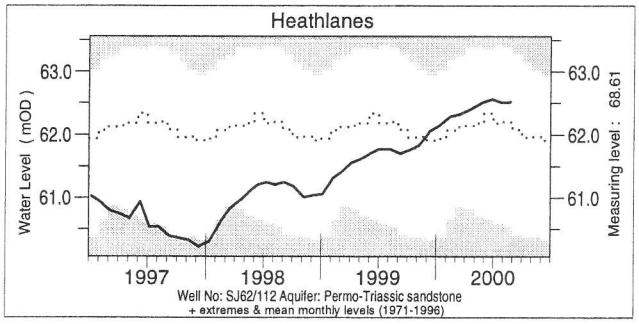


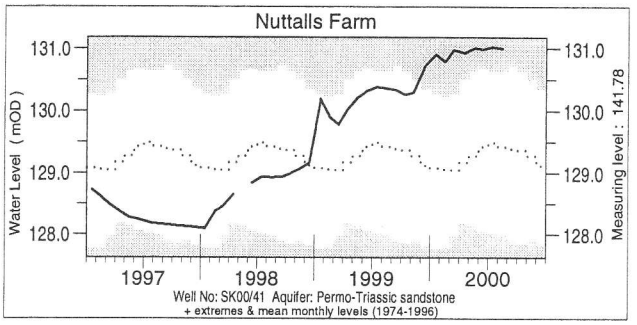


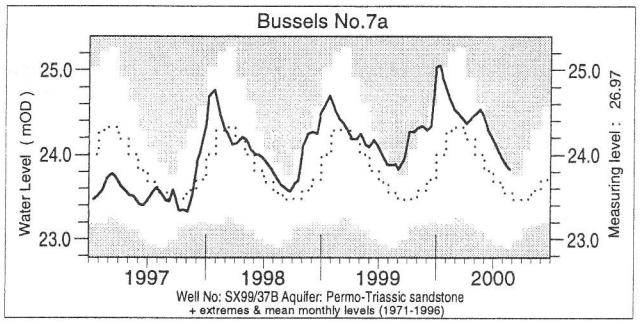


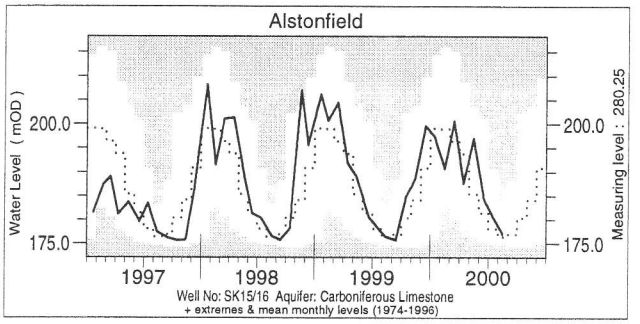












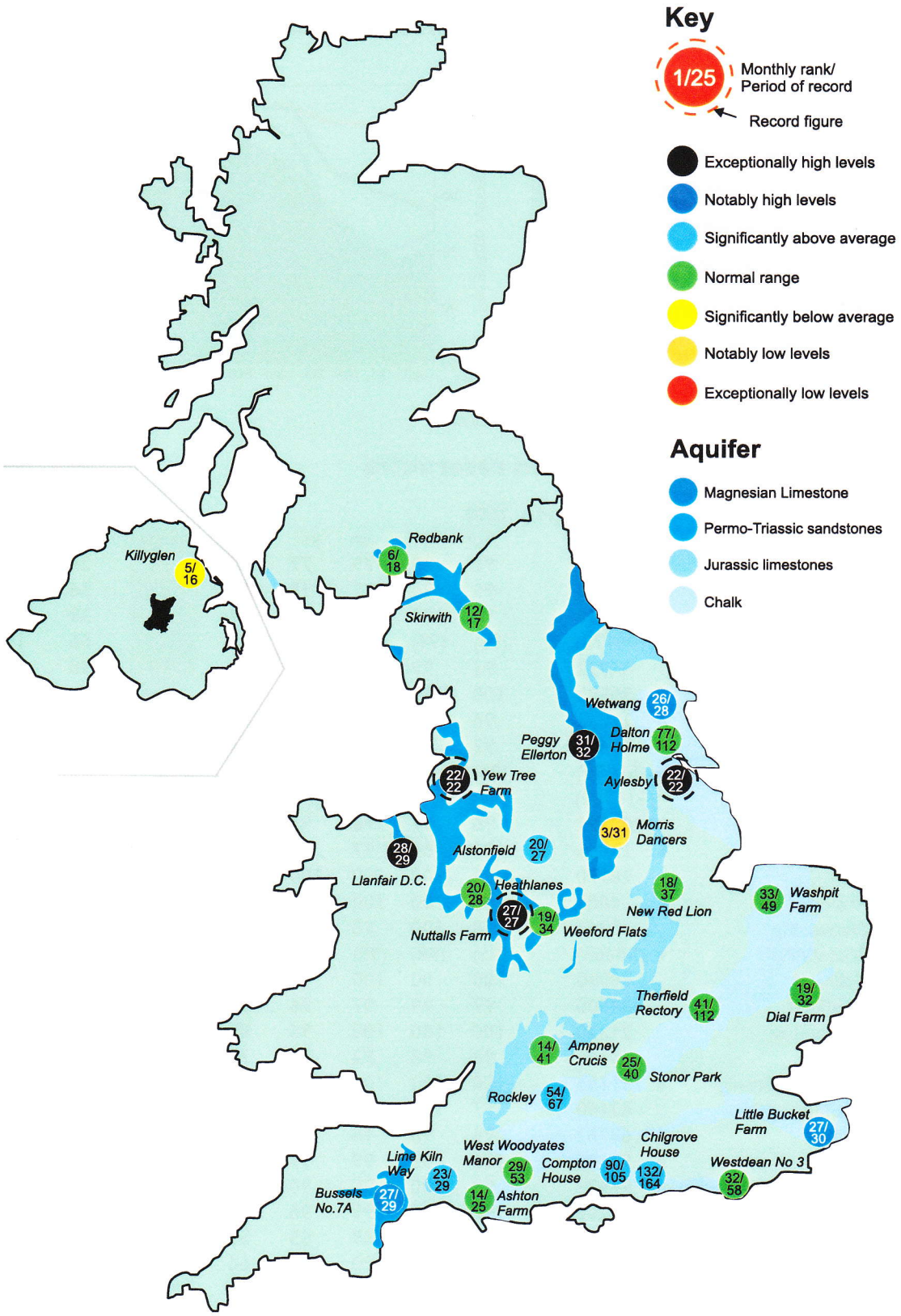
Groundwater levels August/September 2000

Borehole	Level	Date	Aug av.
Dalton Holme	16.97	25/08	16.26
Washpit Farm	45.19	16/08	44.36
Therfield Rectory	78.81	29/08	80.85
Dial Farm	25.69	04/08	25.57
Rockley	133.10	29/08	131.97
Little Bucket	71.97	30/08	66.69
West Woodyates	74.10	31/08	73.93

Borehole	Level	Date	Aug av.
Chilgrove	43.14	29/08	41.74
Killyglen	113.55	31/08	113.94
New Red Lion	12.80	30/08	12.24
Ampney Crucis	100.00	29/08	100.18
Redbank	7.49	31/08	7.80
Skirwith	130.27	25/08	130.15
Yew Tree Farm	13.75	31/08	13.15

Borehole	Level	Date	Aug av.
Llanfair D.C.	80.07	01/09	79.53
Morris Dancers	31.71	29/08	32.43
Heathlanes	62.52	25/08	62.05
Nuttalls Farm	131.00	14/08	129.45
Bussels No. 7A	23.83	22/08	23.56
Alstonfield	176.99	15/08	176.83

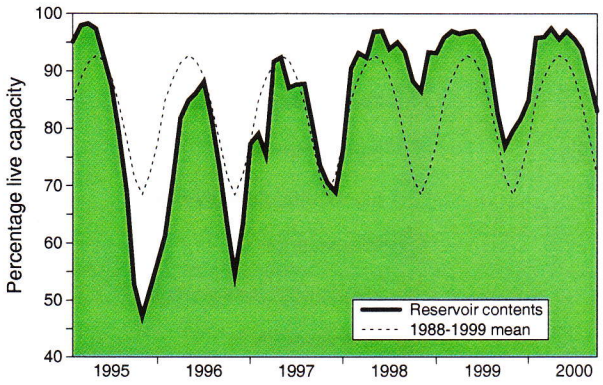
Levels in metres above Ordnance Datum



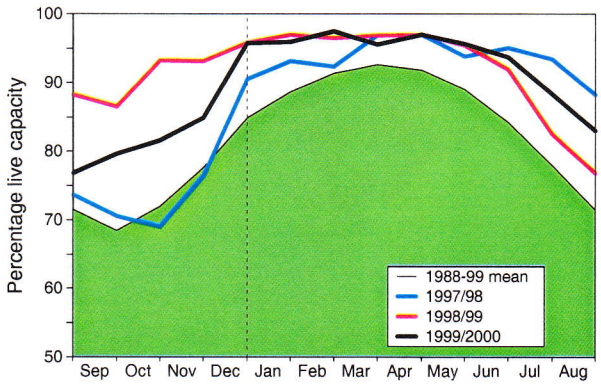
Groundwater levels - August 2000

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 Apr	May	Jun	Jul	Aug	Sep	Min. Sep	Year* of min
North West	N Command Zone	• 133375	92	88	79	77	64	54	24	1995
	Vyrnwy	55146	95	99	95	98	93	89	36	1995
Northumbrian	Teesdale	• 87936	94	100	100	93	87	78	39	1991
	Kielder	(199175)	(90)	(94)	(95)	(92)	(90)	(91)	66	1989
Severn Trent	Clywedog	44922	93	99	99	99	96	88	38	1989
	Derwent Valley	• 39525	100	100	100	92	86	75	34	1995
Yorkshire	Washburn	• 22035	94	100	99	90	83	76	34	1995
	Bradford supply	• 41407	93	99	92	90	76	67	21	1995
Anglian	Grafham	** (55490)	(94)	(96)	(91)	(92)	(93)	(92)	59	1997
	Rutland	**(116580)	(95)	(97)	(96)	(94)	(90)	(84)	66	1995
Thames	London	• 206399	96	97	96	96	88	83	62	1995
	Farmoor	• 13843	88	81	97	95	96	98	64	1995
Southern	Bewl	28170	98	100	100	100	93	85	38	1990
	Ardingly	4685	100	100	100	99	93	78	47	1996
Wessex	Clatworthy	5364	98	100	98	93	80	66	31	1995
	Bristol WW	• (38666)	(95)	(98)	(99)	(92)	(87)	(77)	43	1990
South West	Colliford	28540	100	100	100	98	95	90	43	1997
	Roadford	34500	97	99	97	96	94	92	40	1995
	Wimbleball	21320	100	100	100	96	89	80	40	1995
	Stithians	5205	98	98	92	84	74	58	30	1990
Welsh	Celyn and Brenig	• 131155	100	100	100	100	99	97	49	1989
	Brianne	62140	97	100	100	99	96	92	55	1995
	Big Five	• 69762	96	98	98	96	87	78	29	1995
	Elan Valley	• 99106	100	100	99	97	94	88	46	1995
East of Scotland	Edinburgh/Mid Lothian	• 97639	99	100	95	90	84	76	45	1998
	East Lothian	• 10206	97	100	99	96	93	93	63	1989
West of Scotland	Loch Katrine	• 111363	88	84	69	65	53	50	50	2000
	Daer	22412	97	97	90	80	66	68	41	1995
	Loch Thom	• 11840	97	92	79	69	59	60	58	1997
Northern Ireland	Silent Valley	• 20634	57	58	56	57	42	56	34	1995

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

Details of the individual reservoirs in each of the groupings listed above are available on request. The featured reservoirs may not be representative of the storage conditions across each region; this can be particularly important during droughts. The minimum storage figures relate to the 1988-2000 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 cooperation of all data suppliers is gratefully acknowledged.

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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