Hydrological summary

for the United Kingdom

September 1999

General

September was a remarkably mild month – the warmest since 1949 – and most regions registered above average rainfall. Seasonal recoveries in runoff and recharge rates began in much of the west and north; spate conditions triggered minor floodplain inundations and several flood alerts. Generalising, reservoir stocks declined modestly in the east but increased briskly in the west. Overall stocks for England and Wales remain considerably above average for the early autumn. Groundwater levels are below average in a few eastern aquifer units but, with a rapid decline in soil moisture deficits since mid-September, the resources outlook is good.

Rainfall

The episodic weather patterns which characterised most of the summer half-year continued in September. 'Indian Summer' conditions - with very limited rainfall in the lowlands - were superseded in mid-month by a spell of exceptionally unsettled weather. In Dorset, Dorchester reported its wettest day (69.4 mm on the 18th) since the monumental Martinstown storm of July 1955. 30 mm totals in 24 hours were common on the 18th heralding an eight-day period during which a succession of frontal systems produced rainfall totals in excess of the September average in many areas. Correspondingly, only a few areas - mostly in north-west Britain - registered below average rainfall for the month. Most areas were wet, a few (e.g. in the West Midlands and southern England) recording over 200% of the mean. Provisionally, Northern Ireland registered its third wettest September this century. For some catchments the August/September totals are even more notable. The Lower Wey catchment reported it highest 2-month rainfall total in 80 years. For England and Wales the pairing was the second wettest since 1968. Three month rainfall totals are modestly below average in parts of northern Britain but totals for the summer half-year (April-September) are above average in all regions, notably so in parts of the South and the Midlands. In the Oct. 98-Sept. 99 timeframe rainfall totals are also very healthy – the provisional Scottish total ranks fourth highest in a series from 1869.

River Flows

Reflecting the variety of weather patterns – the track of frontal systems in particular – September flows displayed wide spatial and temporal variability. Generalising broadly, recessions continued over the first half of the month and particularly depressed flow rates were reported for some rivers draining impermeable lowland catchments (e.g. the Wallington, Soar, and Great Stour). Thereafter, recoveries gathered momentum in many responsive western and northern catchments – producing local flooding and significant transport disruption in most regions (e.g. in Northern Ireland around the 20th and North Wales around the 29th). On the 20th, the Tay recorded its second highest flow rate for the summer half-year in a series from 1956. New maximum September peak flows were reported for the Otter and Yscir, and the Welsh Dee registered its highest September flow for over 40 years. By month-end, healthy flow rates characterised most index rivers. Nonetheless, monthly runoff totals were below average in many eastern catchments. By contrast, September mean flows in a number of southern rivers – including the Brue and Stour (Dorset) - were close to the highest on record, the September mean flow for the Otter was unprecedented. Runoff for the summer half-year was a little below average for many lowland rivers but notably high in the west. With the exception of a few rivers, mostly in the South-East, 12-month runoff accumulations are considerably above average, and unprecedented in a few index catchments e.g. the Yscir, Clyde and Camowen.

Groundwater

Above average temperatures and sunshine amounts produced above average evaporative demands in September but sustained rainfall over the latter half of the month briskly reduced soil moisture deficits, allowing infiltration to begin over much of the west and north. By month-end recoveries were underway in the more responsive aquifers (note: in some index wells the September level was measured before the seasonal upturn). Throughout most of the Chalk – where in parts of the east soil moisture deficits are still substantial - September levels were still in recession and mostly very close to the early autumn average, albeit a little below in parts of the eastern lowlands and appreciably above in Northern Ireland. Near-average levels characterised most limestone areas and most minor aquifers also (e.g. the Suffolk Crag). The Permo-Triassic sandstones outcrops displayed much less spatial coherence with early recoveries producing seasonally high levels at Bussels and Yew Tree Farm but levels are still depressed in a few very slow responding eastern outcrops (e.g. Morris Dancers). Generally, the likelihood of a full recharge season over the coming winter makes for an encouraging outlook.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall. .

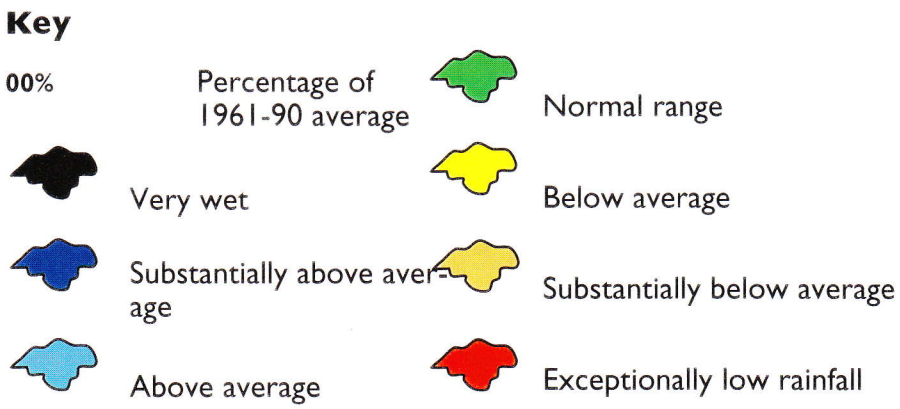
Rainfall accumulations and return period estimates

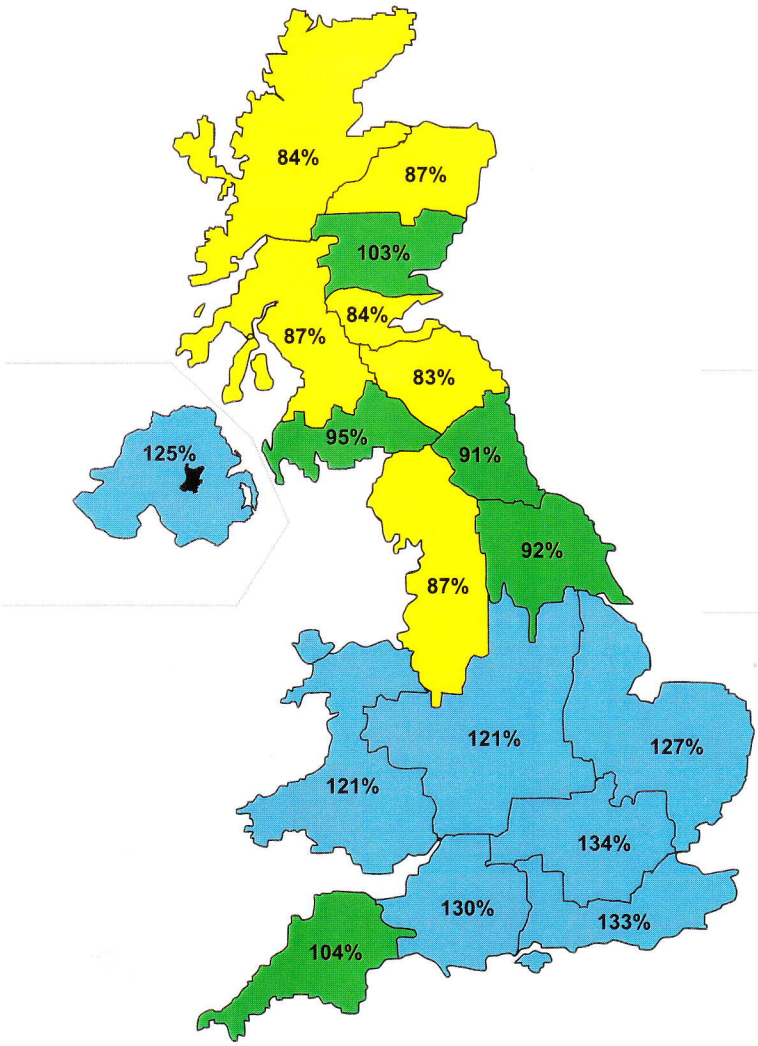
Area	Rainfall	Sep 1999	Jul 99-Sep 99	RP	Apr 99-Sep 99	RP	Jan 99-Sep 99	RP	Oct 98-Sep 99	RP
England & Wales	**mm**	**115**	**238**		**442**		**673**		**982**	
	%	**149**	**111**	**2-5**	**109**	**2-5**	**107**	**2-5**	**110**	**2-5**
North West	mm	143	266		539		880		1317	
	%	124	87	2-5	101	2-5	106	2-5	110	2-5
Northumbrian	mm	87	199		434		673		957	
	%	120	91	2-5	109	2-5	110	2-5	112	5-10
Severn Trent	mm	107	223		427		658		930	
	%	167	121	2-5	120	5-10	121	5-10	123	10-20
Yorkshire	mm	87	185		412		646		922	
	%	128	92	2-5	108	2-5	110	2-5	112	5-10
Anglian	mm	80	194		353		506		725	
	%	162	127	5-10	118	5-10	117	5-10	122	10-20
Thames	mm	106	222		405		564		822	
	%	180	134	5-10	124	5-10	115	2-5	119	5-10
Southern	mm	121	231		396		569		874	
	%	175	133	5-10	118	5-10	107	2-5	112	2-5
Wessex	mm	120	247		457		668		985	
	%	167	130	5-10	127	5-10	115	2-5	118	5-10
South West	mm	118	257		531		822		1297	
	%	127	104	2-5	116	2-5	104	2-5	110	2-5
Welsh	mm	185	355		639		1036		1537	
	%	161	121	2-5	120	5-10	118	5-10	117	5-10
Scotland	**mm**	**160**	**306**		**636**		**1113**		**1690**	
	%	**113**	**87**	**2-5**	**106**	**2-5**	**114**	**5-10**	**118**	**15-25**
Highland	mm	173	340		728		1389		2065	
	%	101	84	2-5	106	2-5	119	10-20	117	10-20
North East	mm	124	214		456		680		1016	
	%	143	87	2-5	103	2-5	99	2-5	104	2-5
Tay	mm	182	293		587		995		1505	
	%	160	103	2-5	117	5-10	117	5-10	122	15-25
Forth	mm	119	235		514		824		1334	
	%	108	84	2-5	107	2-5	107	2-5	120	15-25
Tweed	mm	105	207		466		728		1091	
	%	117	83	2-5	105	2-5	106	2-5	112	5-10
Solway	mm	165	333		686		1123		1745	
	%	115	95	2-5	115	2-5	116	5-10	123	20-35
Clyde	mm	181	367		718		1272		1966	
	%	101	87	2-5	104	2-5	111	2-5	116	5-15
Northern Ireland	**mm**	**179**	**320**		**535**		**803**		**1174**	
	%	**183**	**125**	**5-10**	**116**	**2-5**	**109**	**2-5**	**111**	**2-5**

RP = Return period

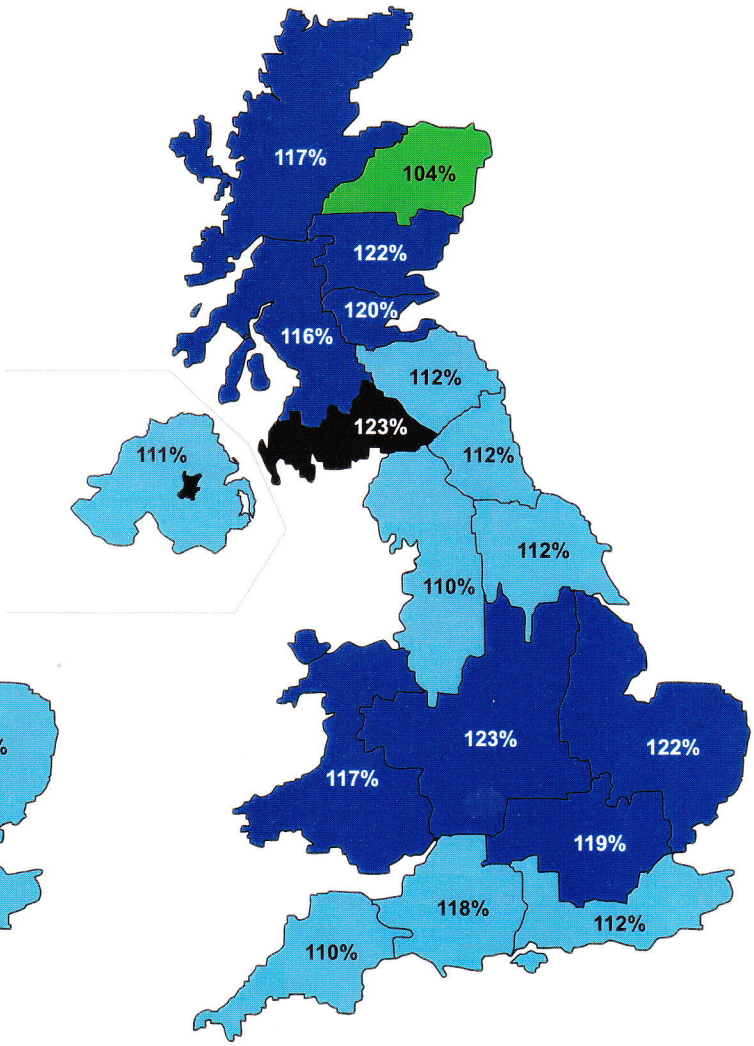
The monthly rainfall figures* are copyright of The Met. Office and may not be passed on to any unauthorised person or organisation. **All monthly totals since July 1998 are provisional (see page 12).** Recent monthly rainfall figures for the Scottish regions have been compiled using data provided by the Scottish Environment Protection Agency. 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





July 1999 - September 1999

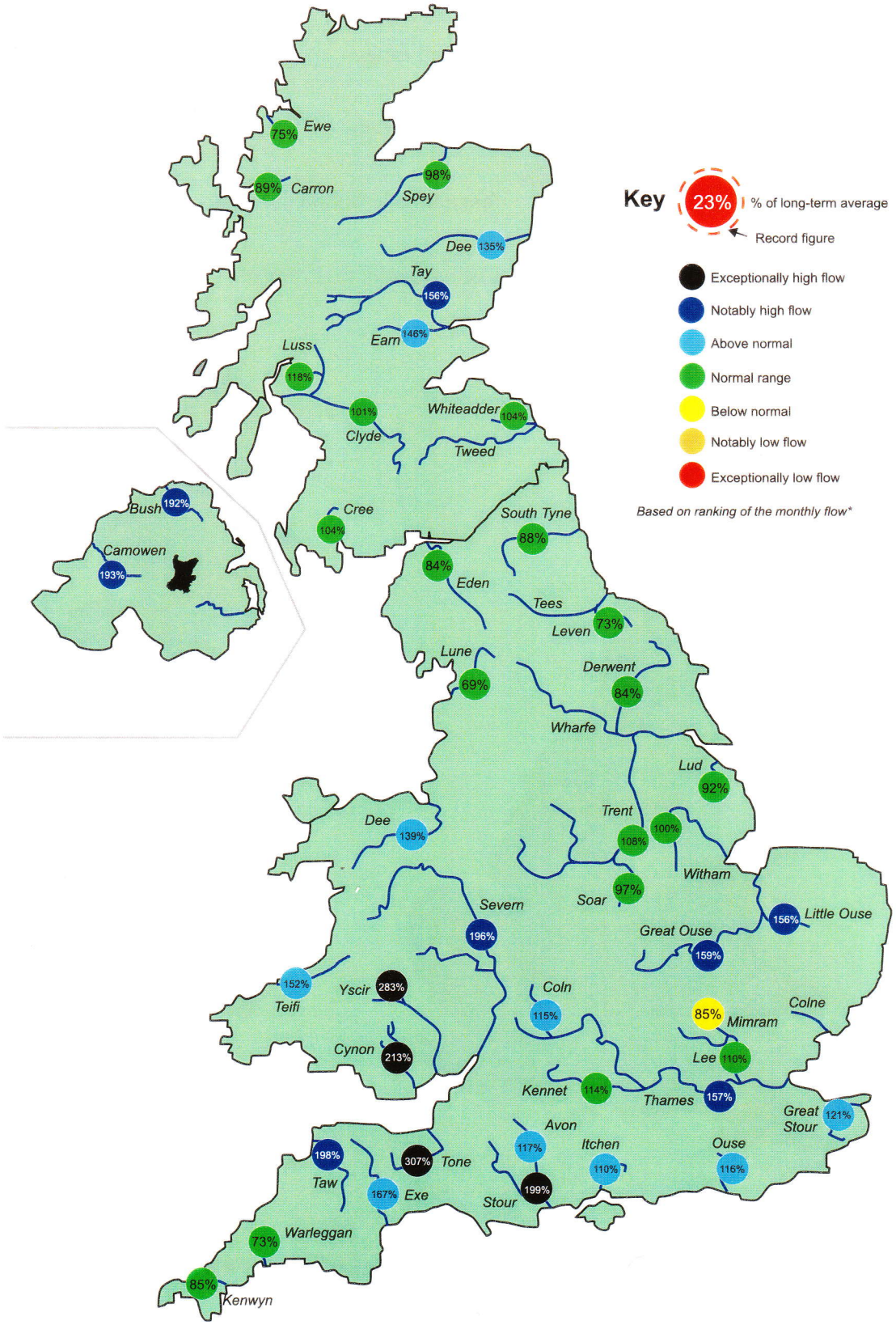


October 1998 - September 1999

Rainfall accumulation maps

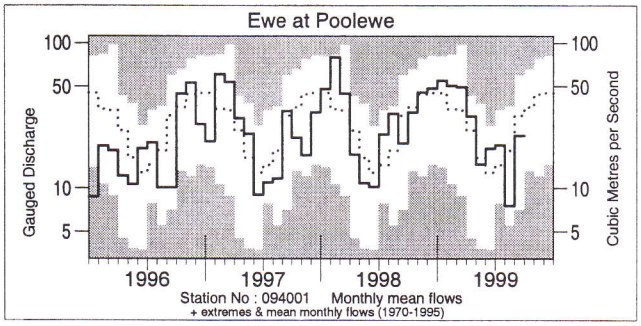
Provisional data indicates that last month's rainfall total for the UK was the second highest (after 1995) for September since 1981. However, the healthy water resources outlook is more a reflection of longer term rainfall accumulations. The provisional October 1998 - September 1999 total is the second highest since 1960 and , in the 24-month timeframe (October - September), 1997 - 99 ranks third wettest this century.

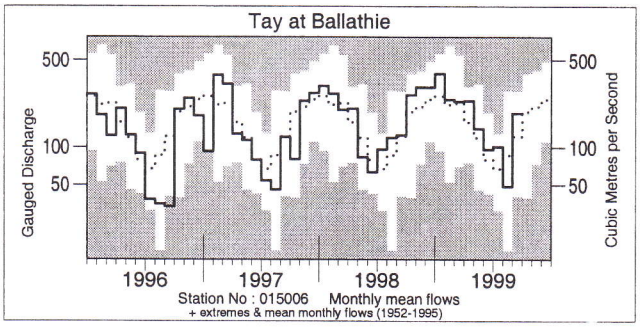
River flow . . . River flow . . .

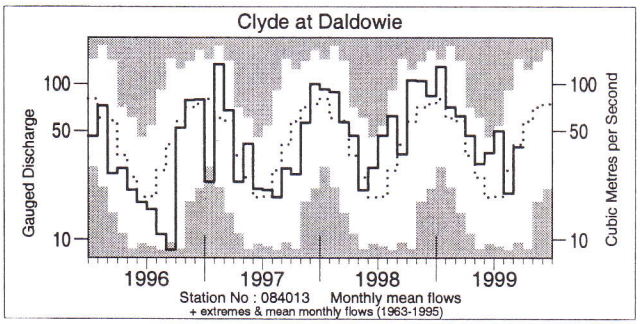


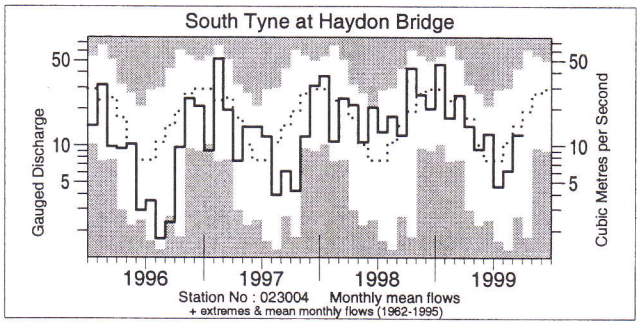
River flows - September 1999

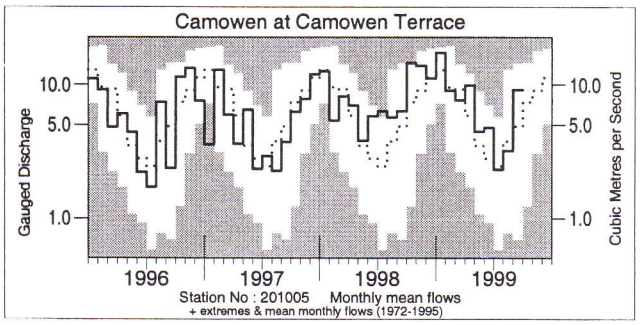
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater.

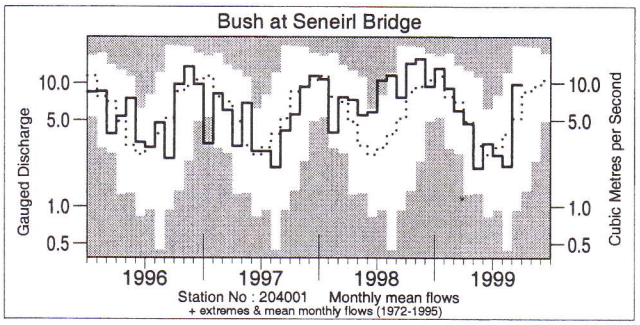


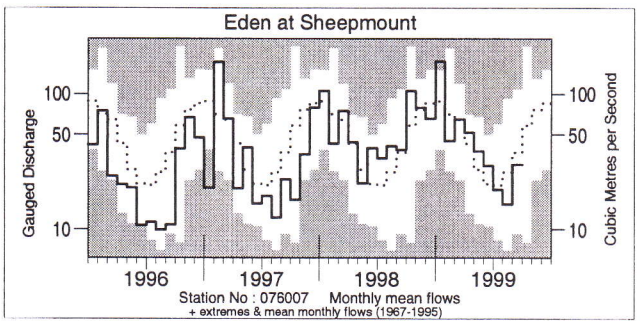


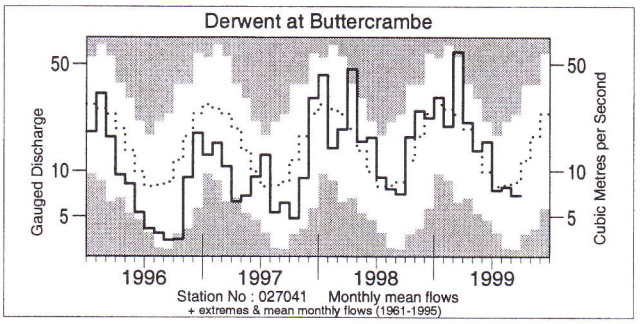


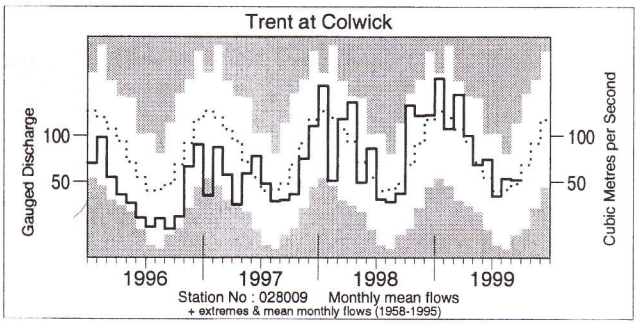


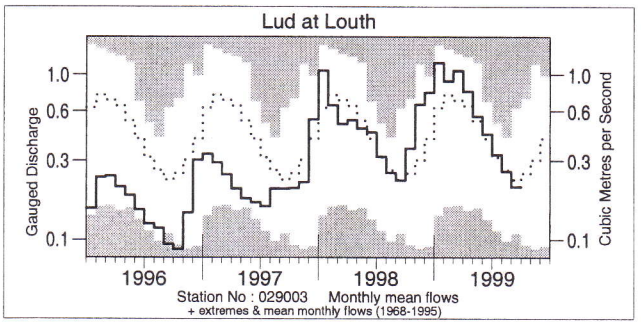








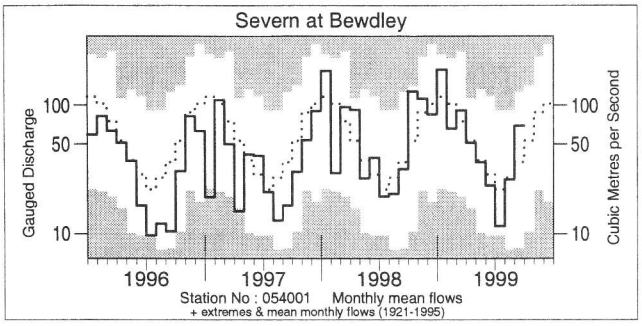


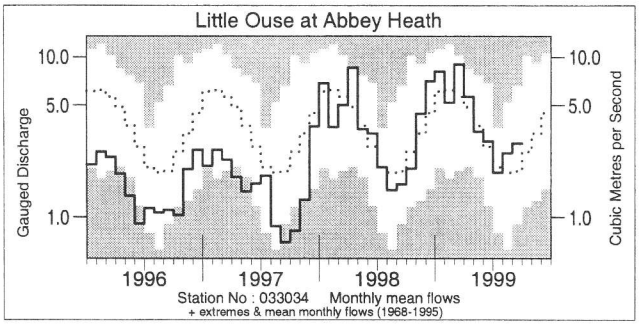


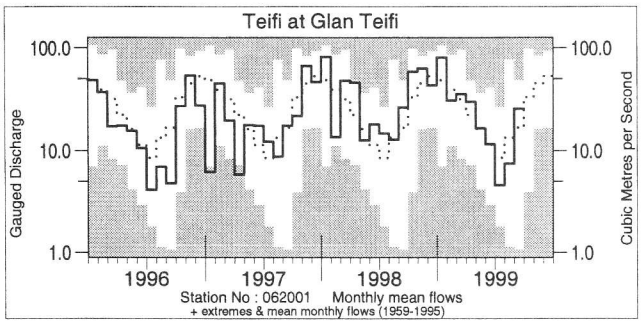
Monthly river flow hydrographs

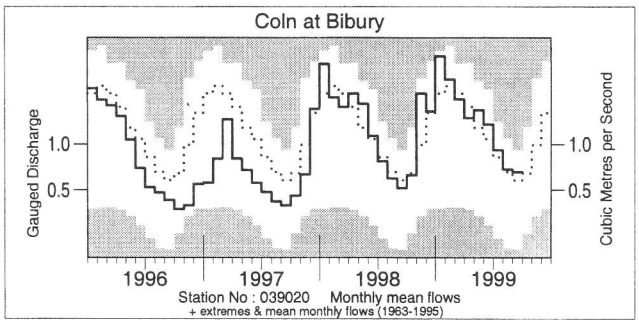
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1996 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

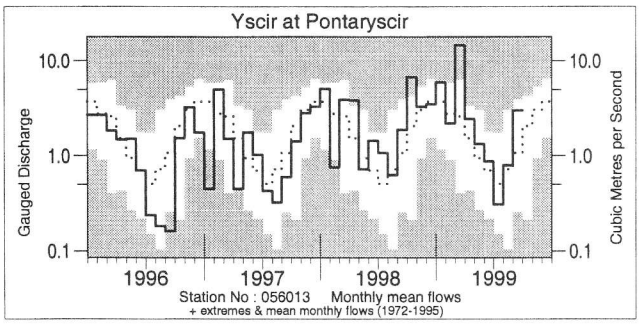
River flow . . . River flow . . .

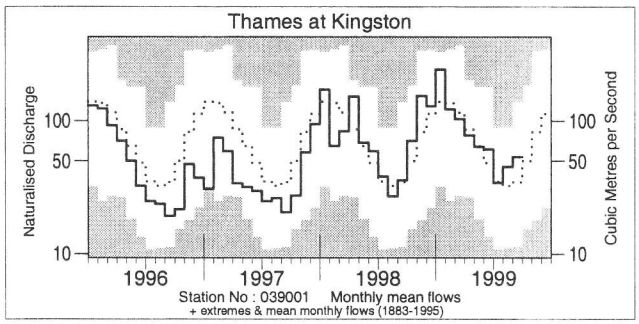


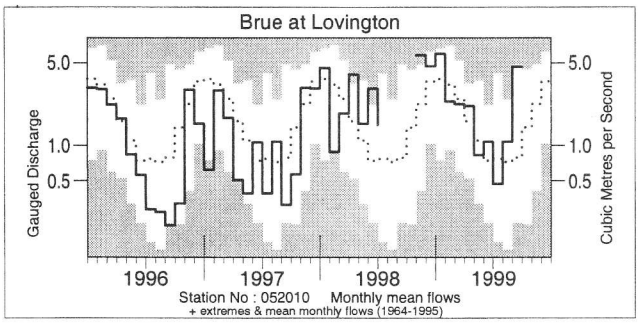


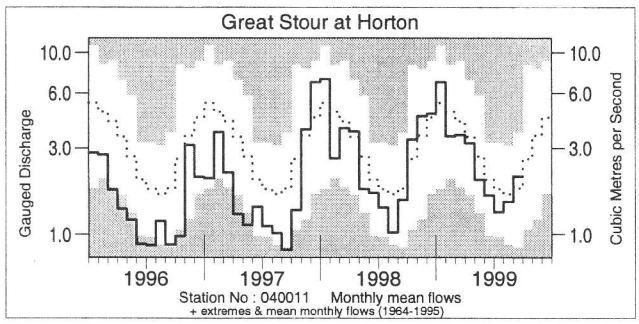


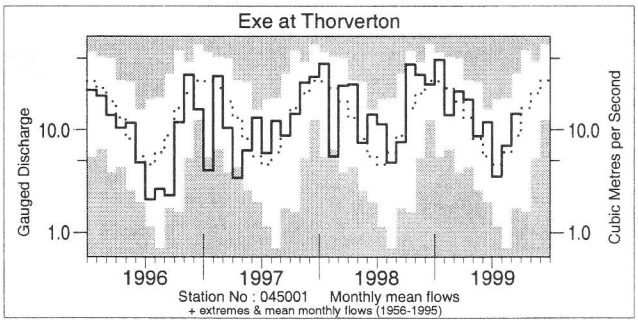


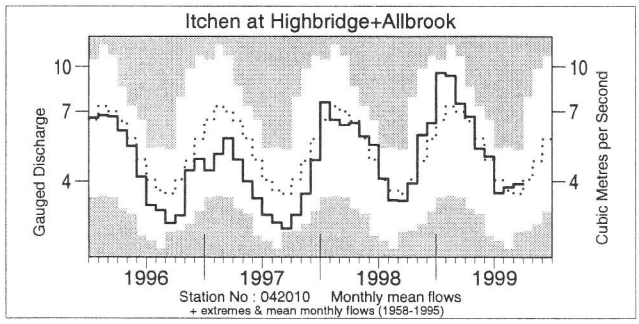










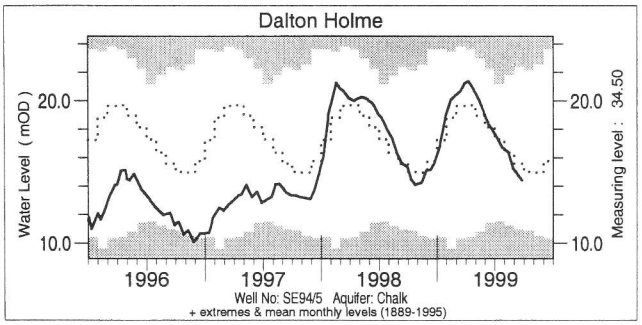


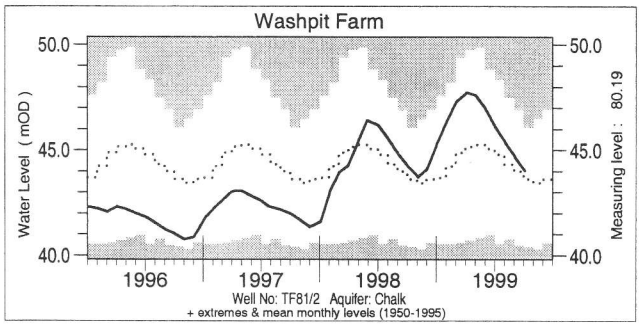
Notable runoff accumulations July 1999 - September 1999 (a); October 1998 - September 1999 (b)

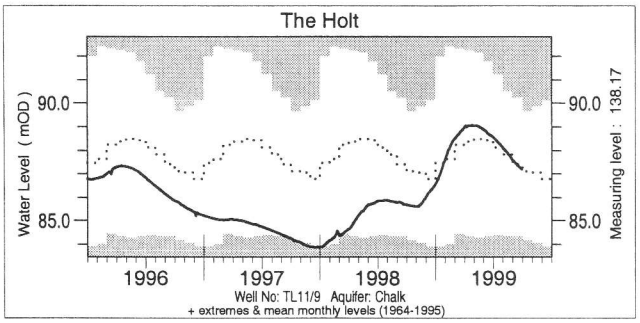
(a) River	%lta	Rank	(b) River	%lta	Rank	River	%lta	Rank
Blackwater	158	46/47	Trent	133	40/41	Earn	130	50/51
Otter	175	36/37	Exe	135	41/43	Clyde	136	36/36
Brue	189	33/34	Yscir	186	26/26	Camowen	130	26/26

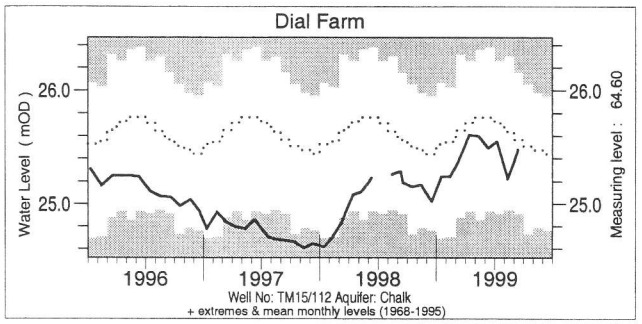
lta = long term average
Rank 1 = lowest on record

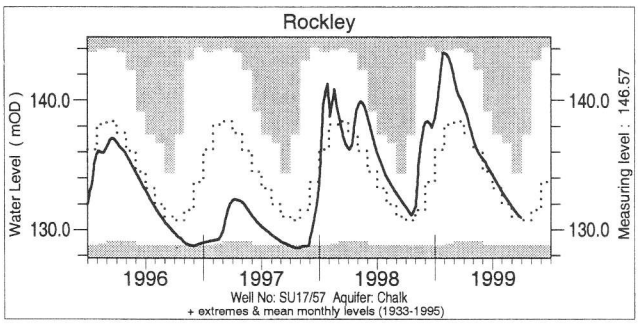
Groundwater . . . Groundwater

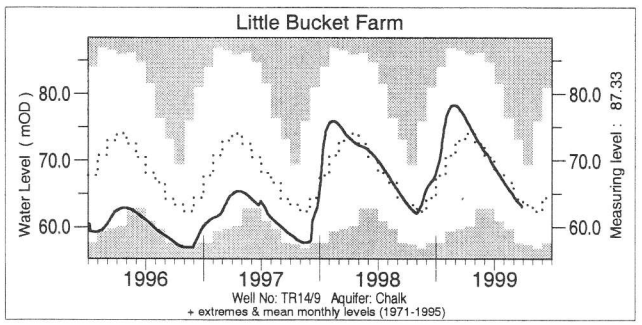


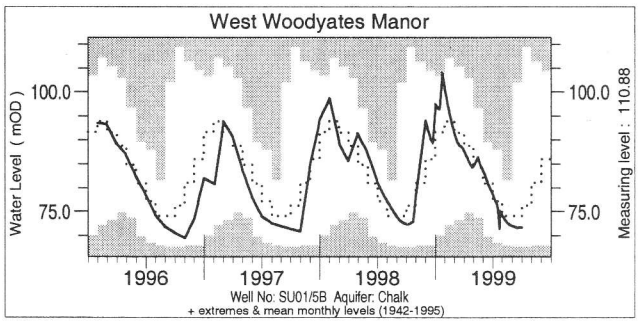


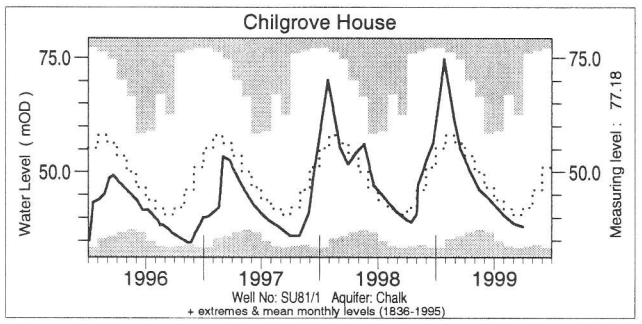


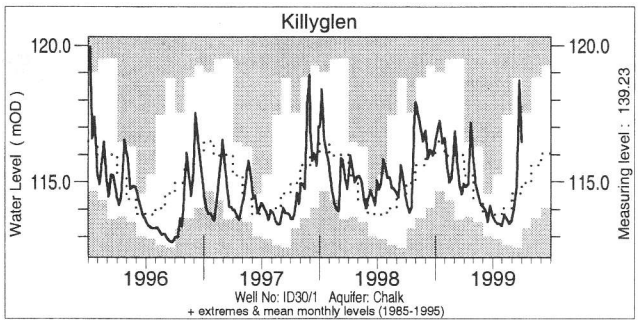


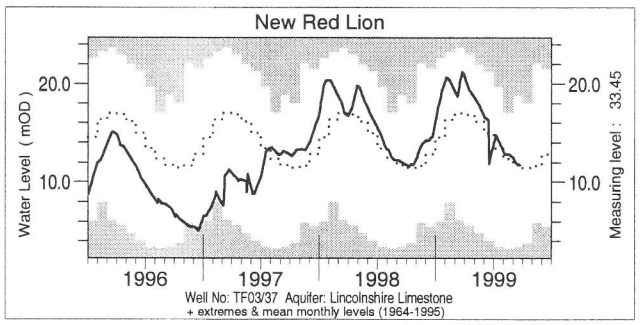








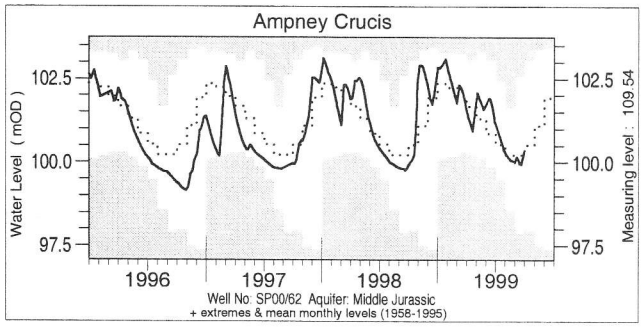


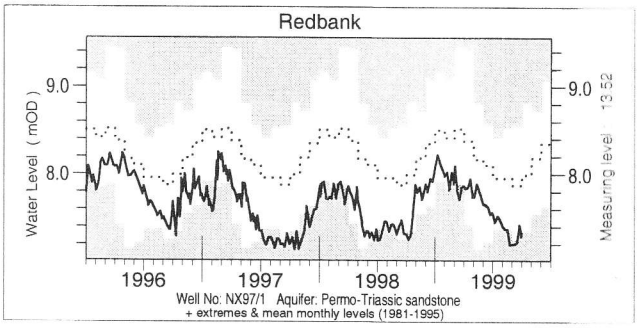


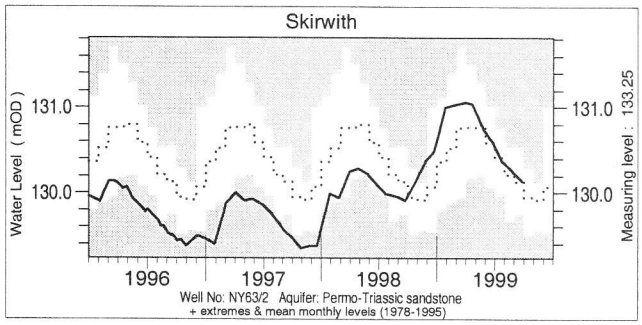
What is groundwater?

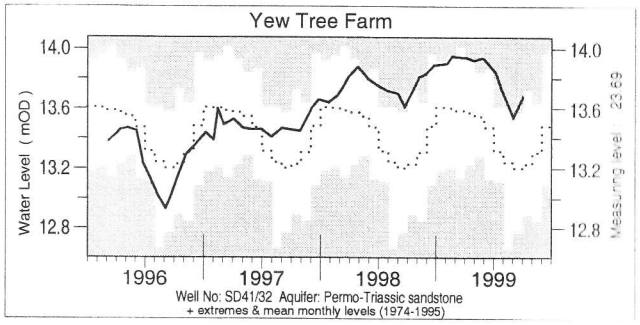
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment 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.

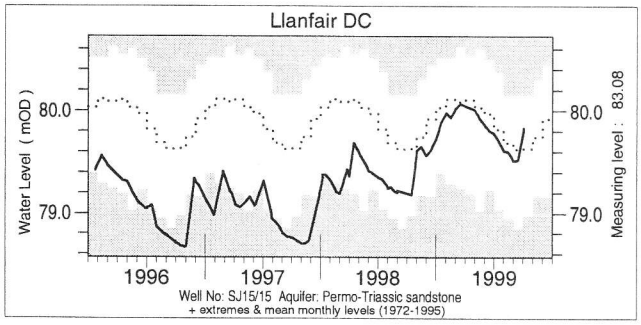
Groundwater . . . Groundwater

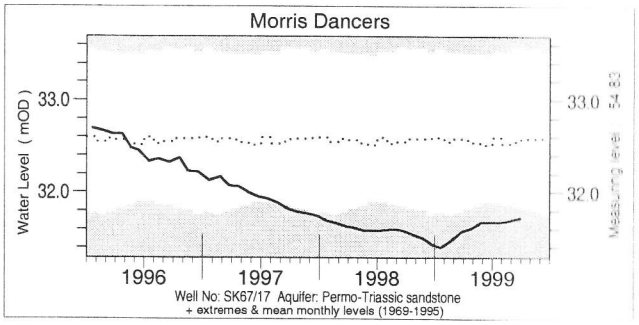


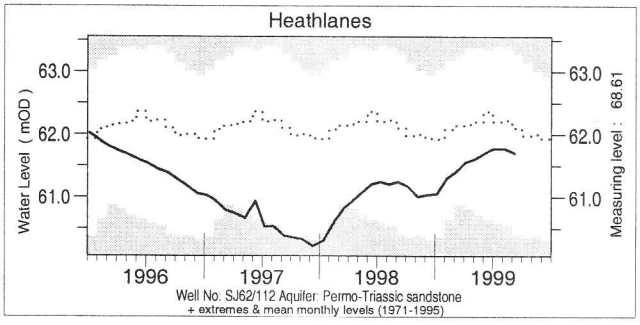


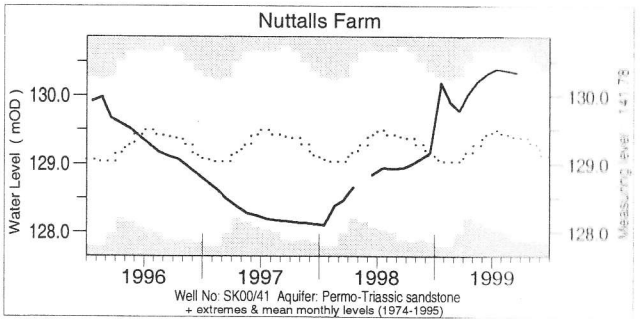


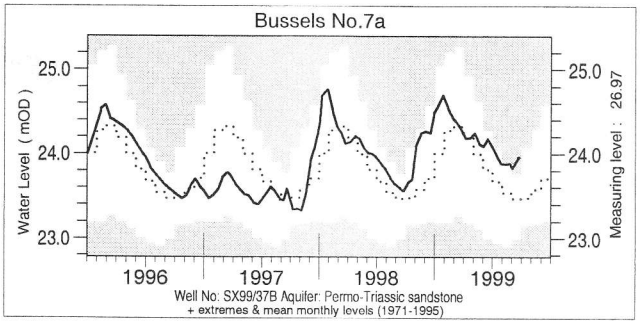


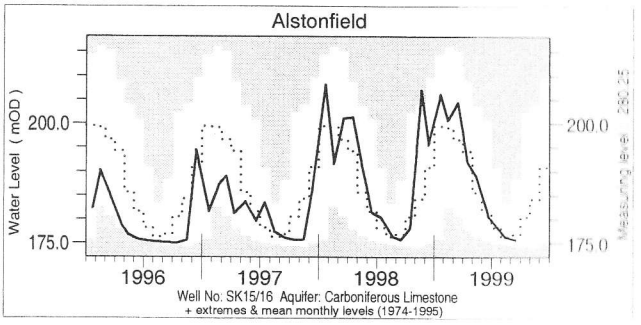










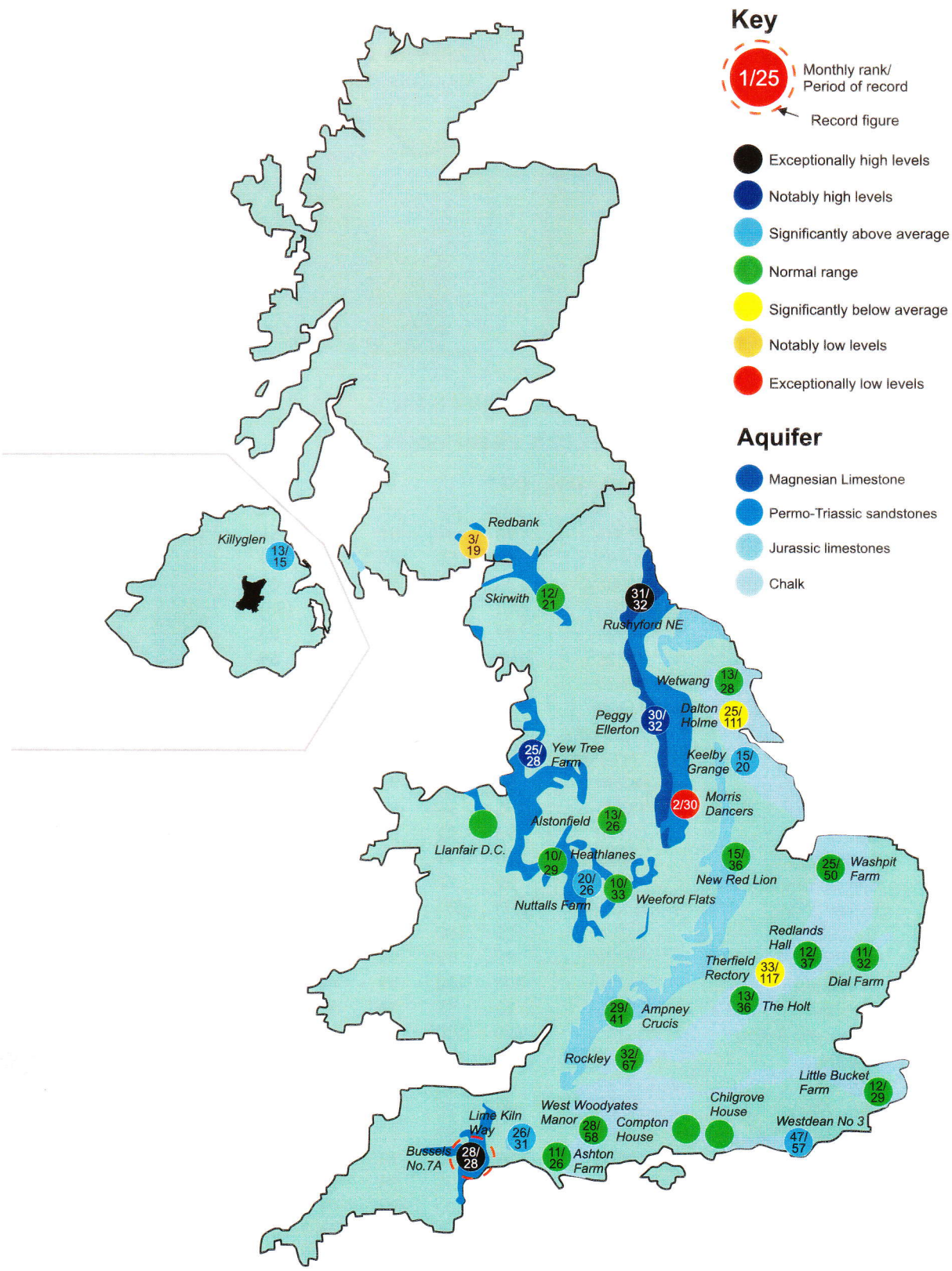


Groundwater levels September/October 1999

Borehole	Level	Date	Sep av.	Borehole	Level	Date	Sep av.	Borehole	Level	Date	Sep av.
Dalton Holme	14.40	24/09	15.45	Chilgrove	38.06	30/09	40.82	Llanfair DC	79.83	03/10	79.46
Washpit Farm	44.01	04/10	43.86	Killyglen	116.47	30/09	114.35	Morris Dancers	31.72	27/09	32.46
The Holt	87.19	28/09	87.33	New Red Lion	11.71	23/09	11.52	Heathlanes	61.71	08/09	61.99
Dial Farm	25.48	13/09	25.55	Ampney Crucis	100.29	28/09	100.10	Nuttalls Farm	130.34	16/09	129.44
Rockley	130.93	28/09	130.97	Redbank	7.29	29/09	7.83	Bussels No. 7A	23.97	22/09	23.48
Little Bucket	63.06	27/09	64.44	Skirwith	130.14	24/09	130.07	Alstonfield	175.77	15/09	177.07
West Woodyates	71.76	30/09	73.11	Yew Tree Farm	13.68	01/10	13.21				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

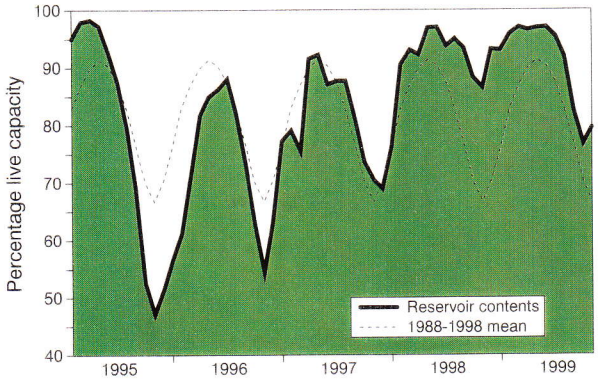


Groundwater levels - September 1999

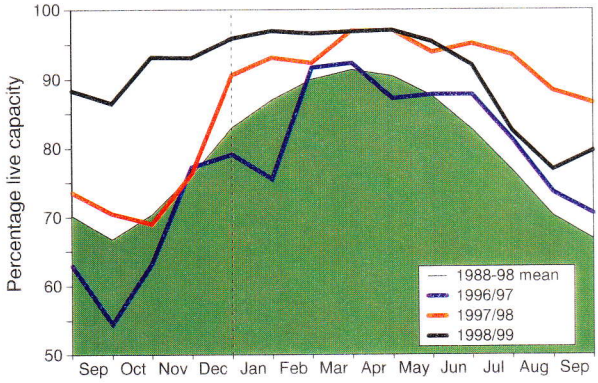
The rankings are normally based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

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.

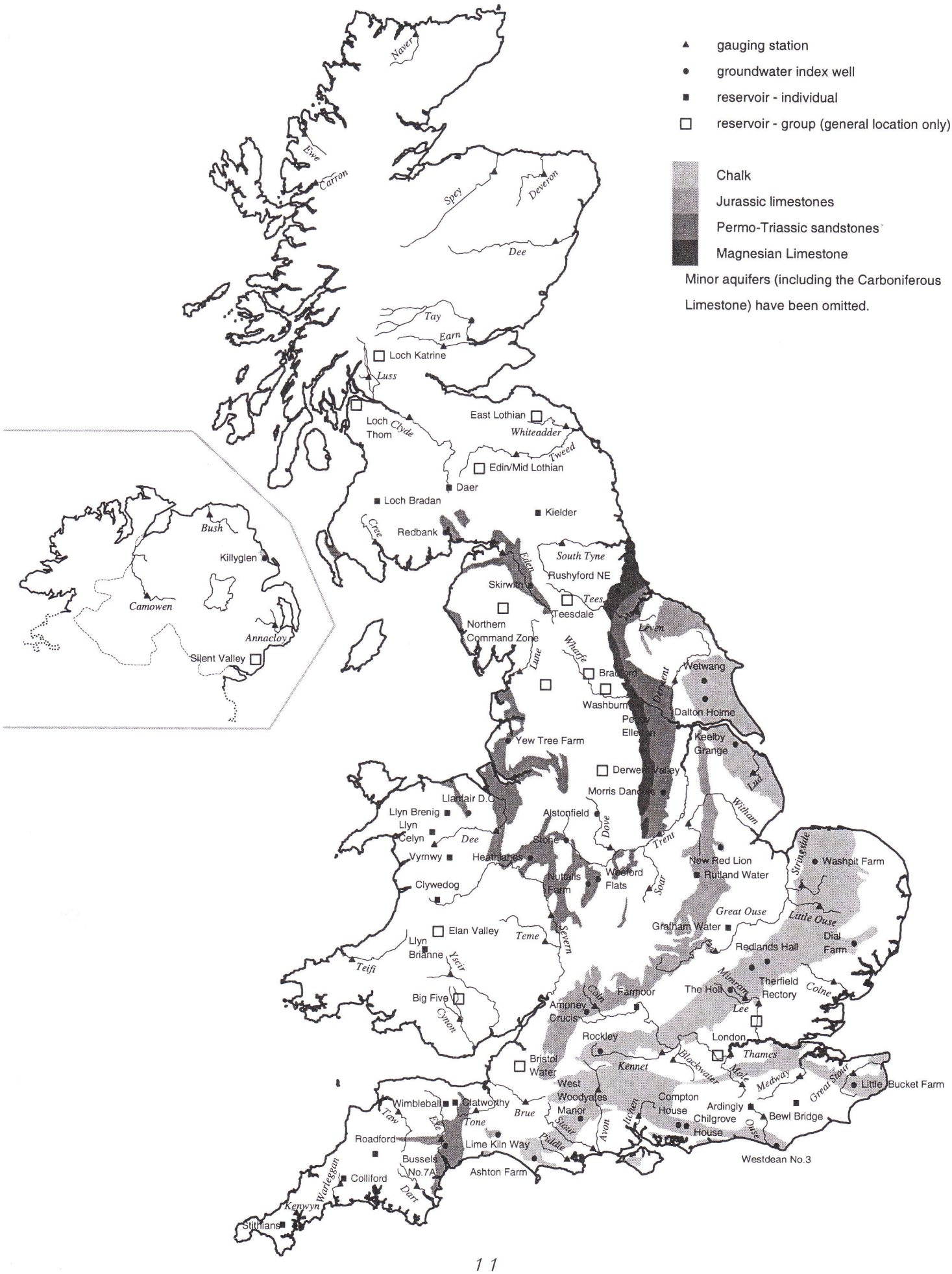
Percentage live capacity of selected reservoirs

Area	Reservoir		Capacity (Ml)	1999 May	Jun	Jul	Aug	Sep	Oct	Min. Oct	Year* of min
North West	N Command Zone	•	133375	96	94	81	71	56	60	13	1995
	Vyrnwy		55146	98	96	87	82	66	81	26	1995
Northumbrian	Teesdale	•	87936	95	94	86	69	61	66	31	1995
	Kielder		(199175)	(95)	(95)	(93)	(89)	(88)	(88)	(59)	1989
Severn Trent	Clywedog		44922	99	99	98	82	83	88	24	1989
	Derwent Valley	•	39525	100	95	90	79	69	64	24	1989
Yorkshire	Washburn	•	22035	98	96	92	83	74	74	24	1995
	Bradford supply	•	41407	98	94	90	77	67	76	15	1995
Anglian	Grafham	**	(55490)	(98)	(96)	(93)	(88)	(89)	(89)	(46)	1997
	Rutland	**	(116580)	(96)	(92)	(88)	(83)	(82)	(79)	(61)	1995
Thames	London	•	206399	95	93	95	89	85	79	53	1997
	Farmoor	•	13843	95	96	99	97	97	95	60	1990
Southern	Bewl		28170	98	92	84	74	66	61	32	1990
	Ardingly		4685	100	99	92	81	61	57	37	1996
Wessex	Clatworthy		5364	99	98	95	75	75	75	30	1995
	Bristol WW	•	(38666)	(97)	(91)	(88)	(76)	(76)	(77)	(31)	1990
South West	Colliford		28540	100	100	99	92	84	81	43	1997
	Roadford		34500	96	93	93	90	87	91	26	1995
	Wimbleball		21320	100	100	99	88	79	81	30	1995
	Stithians		5205	99	98	96	86	77	70	22	1990
Welsh	Celyn and Brenig	•	131155	100	100	100	83	79	86	39	1989
	Brianne		62140	99	100	100	91	87	100	48	1995
	Big Five	•	69762	97	96	92	74	68	87	19	1995
	Elan Valley	•	99106	99	98	92	81	70	77	34	1995
East of Scotland	Edinburgh/Mid Lothian	•	97639	81	82	82	80	71	71	43	1998
	East Lothian	•	10206	99	97	98	94	93	86	52	1989
West of Scotland	Loch Katrine	•	111363	93	95	94	89	74	92	43	1995
	Daer		22412	97	100	91	87	73	80	32	1995
	Loch Thom	•	11840	97	93	89	90	75	82	56	1995
Northern Ireland	Silent Valley	•	20634	84	82	67	58	56	71	27	1995

() figures in parentheses relate to gross storage • denotes reservoir groups *last occurence ** 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 1988-1999 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 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 IH) 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. Initial rainfall estimates for Scotland and the Scottish regions are derived by IH in collaboration with SEPA. Beginning with the June 1999 report, provisional rainfall figures for England and Wales, the EA regions and Northern Ireland, have been derived by the UK Climate Studies Group at The Met. Office. In England and Wales, earlier 1999 provisional rainfall figures derive from MORECS. MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain. The discontinuation of the CARP system used by The Met. Office to provide more definitive regional rainfall assessments means that the MORECS figures have not been updated. Negotiations are continuing with The Met. Office to provide more accurate areal figures. Until the negotiations are concluded the regional rainfall figures (and the return periods associated with them) should be regarded as a guide only.

The Met. Office
Sutton House
London Road
Bracknell
RG12 2SY
Tel.: 01344 856858; 01344 854024.

The cooperation of all data suppliers is gratefully acknowledged.

Subscription

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