Hydrological summary

for Great Britain

September 1997

General

September was warm and generally sunny but rainfall totals were notably low throughout most of southern Britain. The promise - following a wet summer - of an early, and general, onset of the seasonal recovery in runoff and recharge rates failed to materialise. Reservoir contents remain healthy overall but stocks are well below average in parts of the English lowlands - broadly coinciding with the regions where groundwater levels are approaching, or at, long term minima. The seasonally very dry soils emphasise the need for above average winter rainfall to improve the water resources outlook. A third successive dry winter in the eastern lowlands would produce extremely low water-tables by next summer.

Rainfall

September began in an unsettled vein but, thereafter, anticyclonic conditions diverted most frontal systems to the north of Britain. A few notable storm totals were reported - e.g. 106 mm at Blaenau Ffestiniog on the 16th - but in substantial parts of the English lowlands, precipitation over the last three weeks of the month was largely restricted to fog-drip. By early October, five-week rainfall totals of <10 mm characterised some central and southern districts. September rainfall totals exceeded the average in parts of western Scotland , but were below 40% in much of lowland England, some areas registering less than 20% - and recording their lowest September rainfall since 1959. For England and Wales as a whole it was the driest September since 1986. After declining through the summer, rainfall deficiencies increased once more. 1997 regional rainfall totals are well within the normal range but the April 1995-September 1997 period is the driest 30-month sequence for E & W since the 1850s (although protracted deficiencies approaching the current magnitude occurred in 1974-76 and 1990-92). Outstandingly low long term rainfall accumulations continue to be registered in north-west England but the drought now focuses on lowland England where deficiences are also exceptional; for instance the last 30 months are the driest in the Thames basin in a series from 1883.

River Flow

Frontal rainfall at intervals through the month produced substantial flow variation in some western and northern catchments and a few, mostly minor, spates were reported early in the month and around the 13-18th (e.g. on the Lune). Away from western Scotland however, very few catchments reported above average monthly runoff. In most of England, recessions became re-established after the wet summer and runoff rates were notably depressed in much of the eastern lowlands. The zone of maximum drought intensity is broadly delineated by those rivers which established new minimum September runoff totals - these include the Little Ouse, Colne (Essex), the Mimram and Test, the latter two typifying the depressed flows in Chalk streams throughout the South-East. Accumulated runoff total are also very low in timeframes ranging from 6 to 30 months in much of Britain; the last two years has produced the lowest 24-month runoff accumulation on record for the Great Stour. Throughout the lowlands this very protracted low flow episode has been accompanied by a substantial, contraction of the river network, a temporary loss of aquatic habitat and, in downstream reaches, a reduction in the available dilution for sewage effluent.

Groundwater

The isolated increases in levels registered in late summer failed to herald any general recovery. Low rainfall totals, and above average September evaporative demands, resulted in little or no infiltration to almost all major aquifer units. In most of the limestone outcrops, September levels were in the normal range but well below average - notably so in the Magnesian Limestone of Yorkshire. In the principal water supply aquifers, levels continue to decline gently - as they approach drought minima over wide areas. In the Permo-Triassic sandstones geographical variations are large - the most depressed levels being in the North-West and the Midlands - new monthly minima were established at Morris Dancers and Heathlanes. Towards the northern and western extremities of the Chalk levels remain unremarkable but the lengthy recessions have produced exceptionally depressed water-tables in a broad zone covering most of the English lowlands. September water-table levels at The Holt are unprecedented; the Therfield well remains dry (for only the second time since 1922) and levels are also notably depressed at Rockley. In much of the drought affected areas around 8-10 weeks of average rainfall will be required to trigger recoveries - from such a low base that if winter rainfall is less than about 75% of average, Chalk levels may fall to unprecedented minima by the end of the 1998 recession.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall. .

Rainfall accumulations and return period estimates

Area	Rainfall	Sept 1997	Jul 97-Sept 97	RP	Jan 97-Sept 97	RP	Oct 96-Sept 97	RP	Apr 95-Sept 97	RP
England & Wales	**mm**	**32**	**186**		**572**		**845**		**1814**	
	%	**41**	**87**	**2-5**	**91**	**2-5**	**94**	**2-5**	**83**	**40-60**
NorthWest	mm	69	224		745		1105		2236	
	%	60	73	5-10	90	2-5	92	2-5	76	>200
Northumbrian	mm	36	162		597		866		1848	
	%	49	74	5-10	98	2-5	102	2-5	88	10-15
SevernTrent	mm	29	159		514		734		1540	
	%	45	87	2-5	95	2-5	97	2-5	83	30-45
Yorkshire	mm	23	156		530		797		1618	
	%	34	78	2-5	91	2-5	97	2-5	80	60-90
Anglian	mm	16	119		386		567		1189	
	%	32	78	2-5	89	2-5	95	2-5	80	60-90
Thames	mm	17	135		405		584		1357	
	%	28	81	2-5	82	5-10	85	5-10	80	40-60
Southern	mm	12	133		444		676		1518	
	%	17	77	2-5	84	5-10	87	2-5	80	40-60
Wessex	mm	35	203		546		816		1916	
	%	49	107	2-5	95	2-5	97	2-5	94	2-5
SouthWest	mm	45	259		735		1125		2551	
	%	49	105	2-5	93	2-5	96	2-5	91	5-10
Welsh	mm	71	278		827		1230		2680	
	%	62	95	2-5	94	2-5	94	2-5	85	20-30
Scotland	**mm**	**120**	**262**		**1008**		**1525**		**3196**	
	%	**84**	**74**	**5-10**	**103**	**2-5**	**106**	**2-5**	**92**	**5-15**
Highland	mm	163	334		1289		1914		3786	
	%	95	83	2-5	111	2-5	109	2-5	90	10-20
North East	mm	45	173		693		1030		2440	
	%	52	70	5-15	101	2-5	106	2-5	102	2-5
Tay	mm	88	191		842		1254		2805	
	%	77	67	5-15	99	2-5	102	2-5	95	2-5
Forth	mm	80	170		777		1186		2465	
	%	73	61	20-30	101	2-5	107	2-5	91	5-10
Tweed	mm	56	152		701		1090		2228	
	%	63	61	15-25	102	2-5	112	5-10	93	5-10
Solway	mm	136	288		926		1455		3094	
	%	95	82	2-5	95	2-5	102	2-5	90	5-15
Clyde	mm	151	307		1095		1695		3605	
	%	84	73	5-10	96	2-5	100	<2	88	10-20

%= % of 1961-90 average

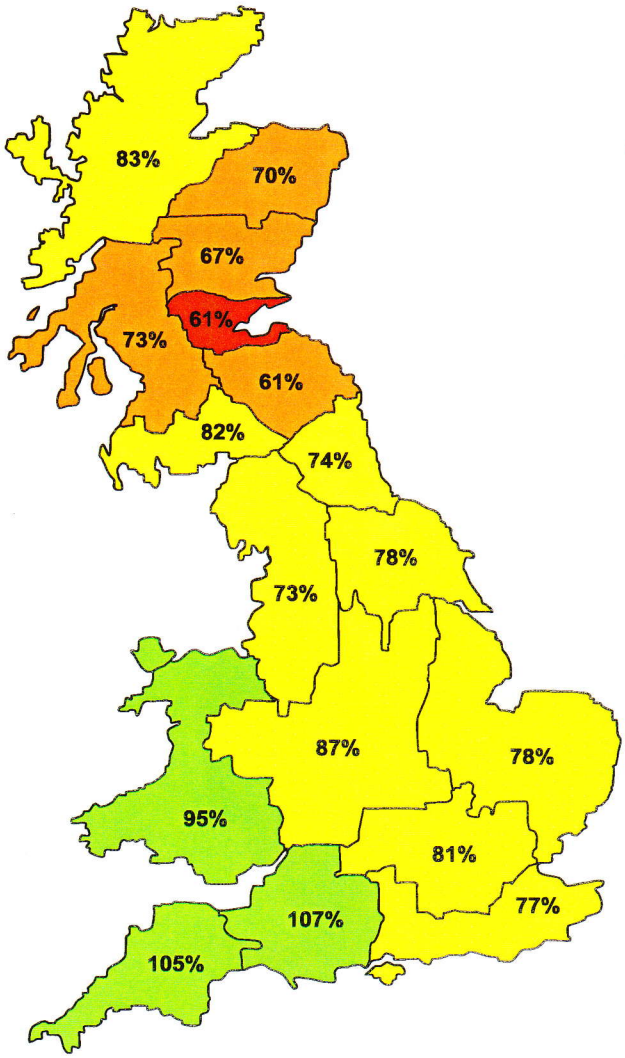
RP = Return period

 Recent monthly rainfall figures for the Scottish regions have ben 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). 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.

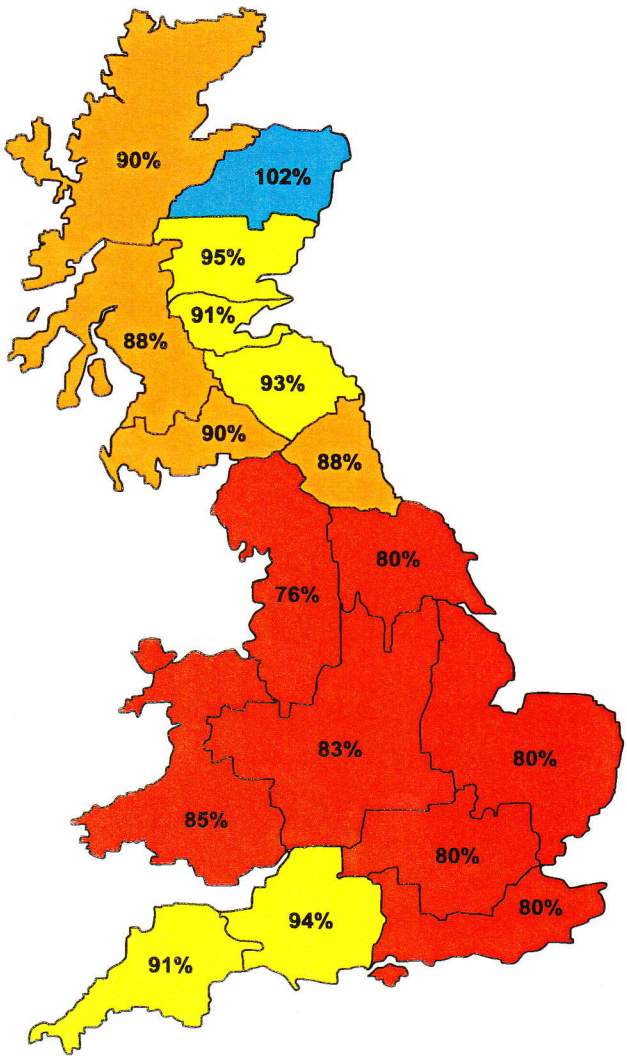
Rainfall . . . Rainfall . . . Rainfall

Key

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



July 1997 - September 1997

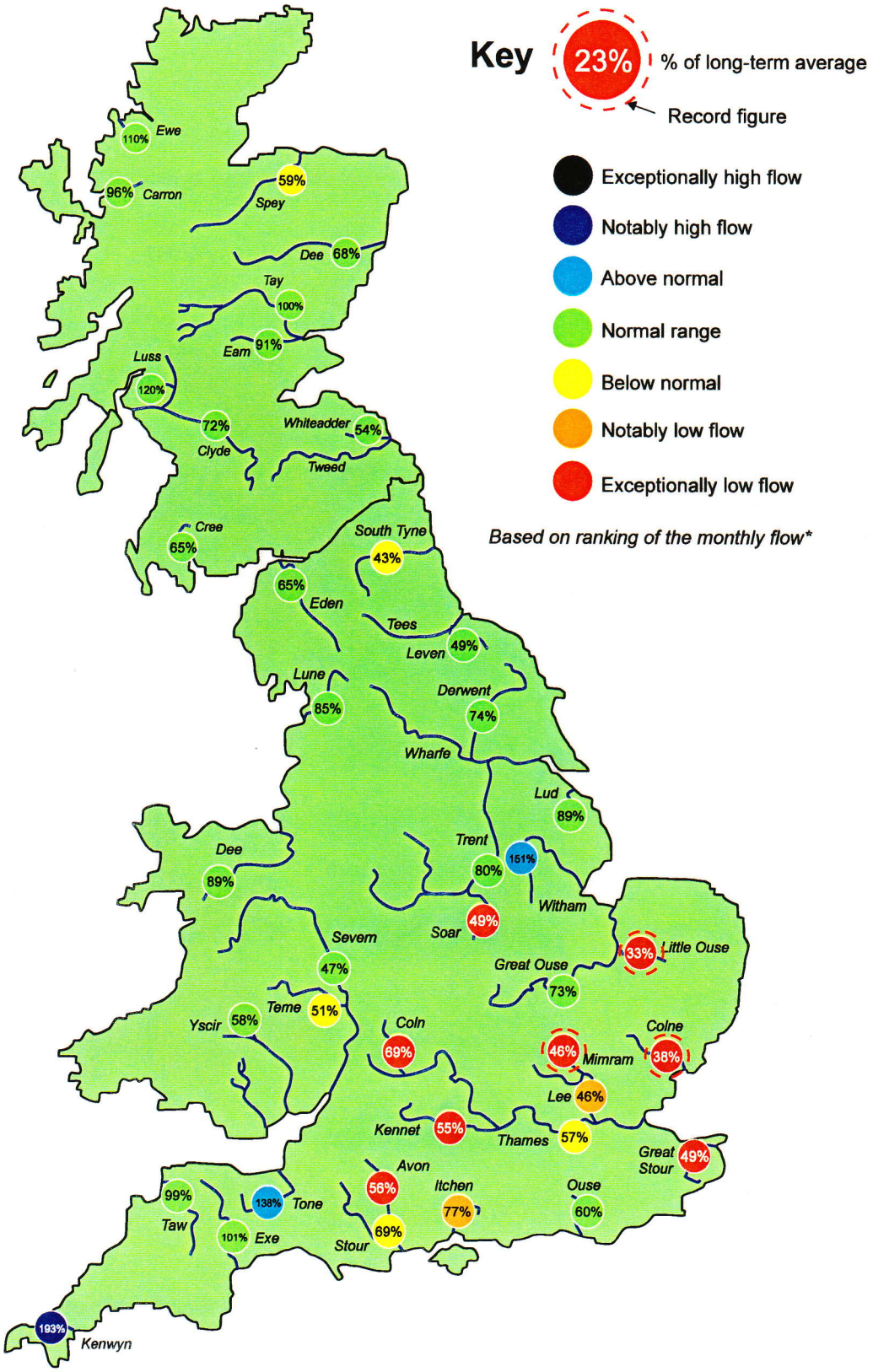


April 1995 - September 1997

Rainfall accumulation maps

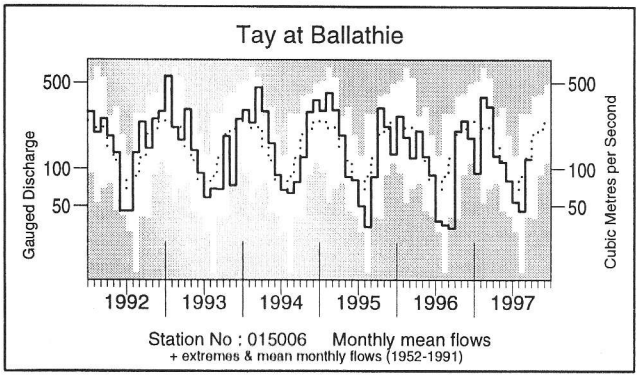
Although the summer (June-August) was wet in most regions, three-month rainfall totals for the period ending with September are mostly below average - notably so in much of Scotland. In hydrological terms, the 30-month deficiency is much more significant with severe long term rainfall deficiencies extending across most of England and Wales.

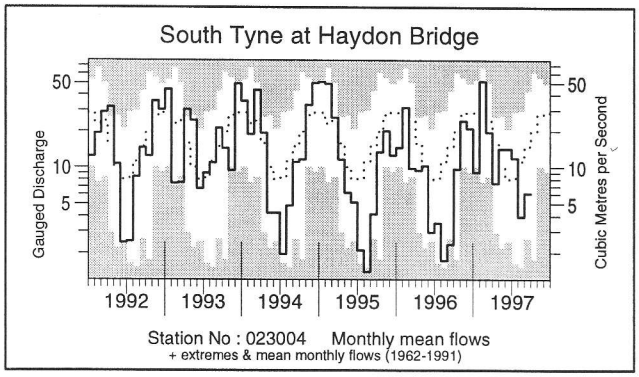
River flow . . . River flow . . .

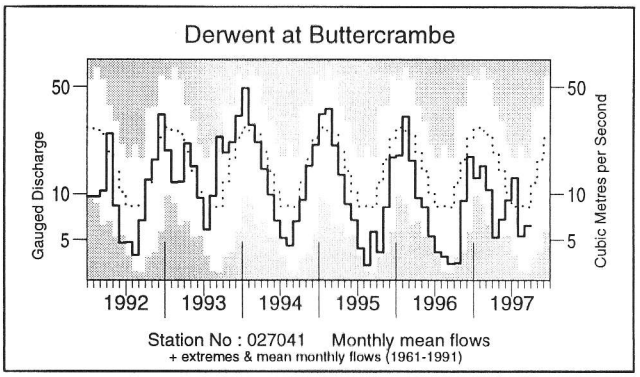


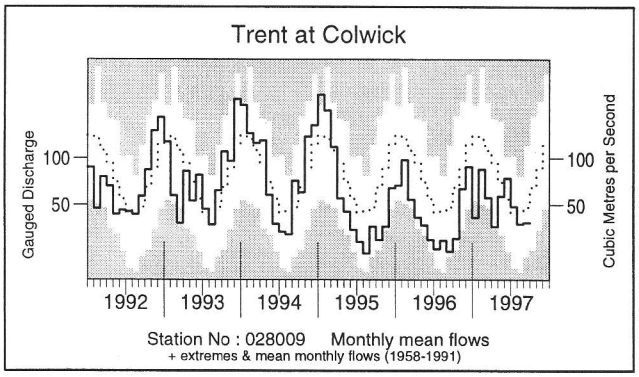
River flows - September 1997

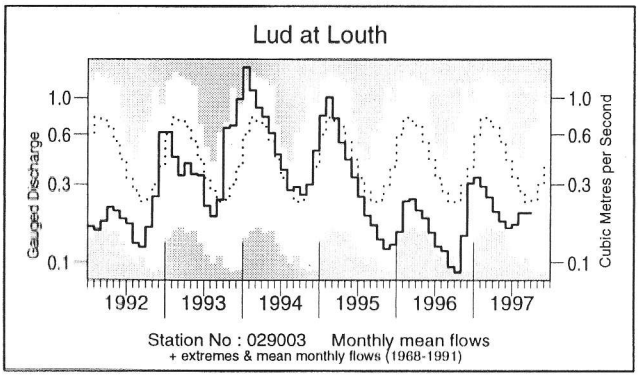
Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

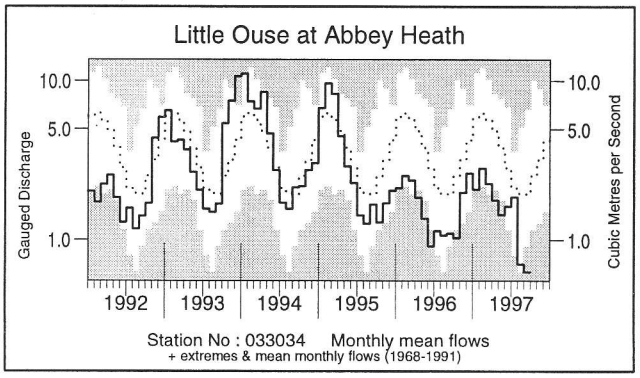


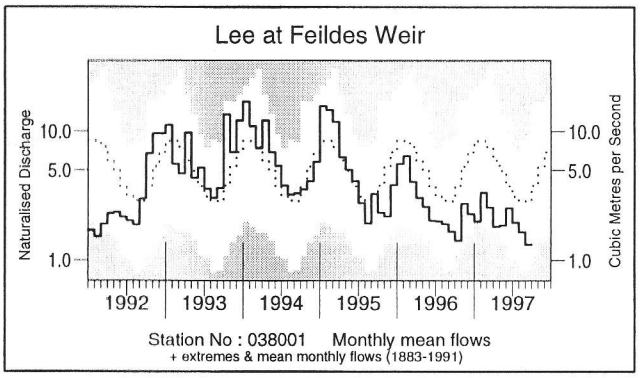


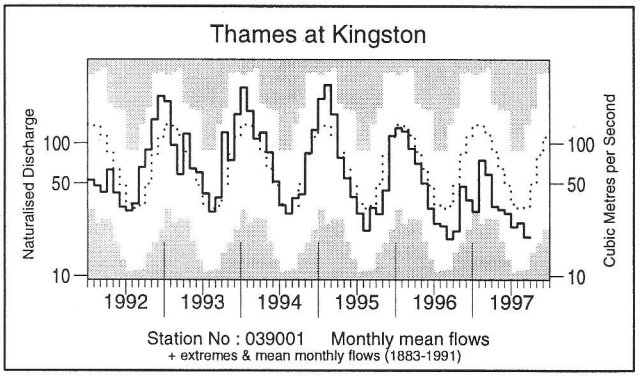








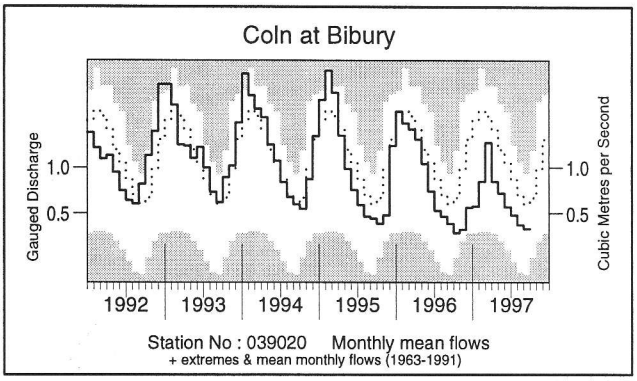


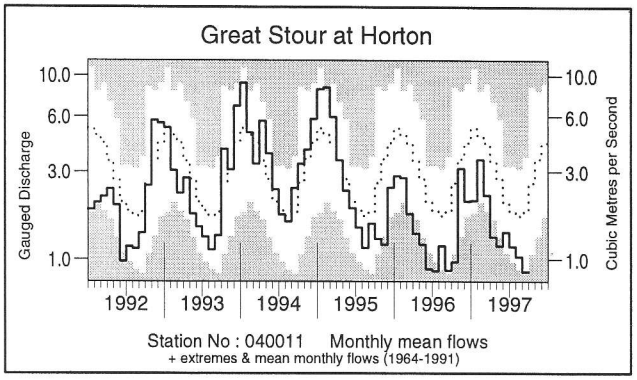


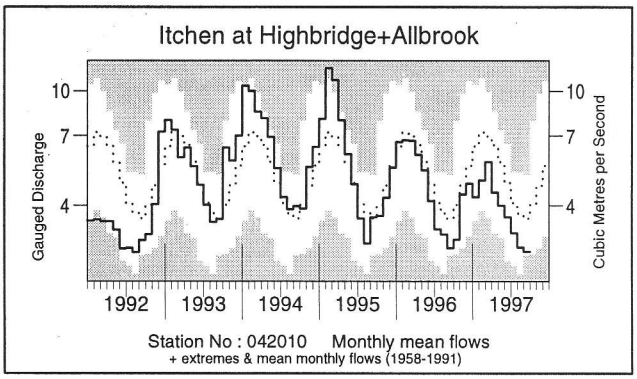
Monthly river flow hydrographs

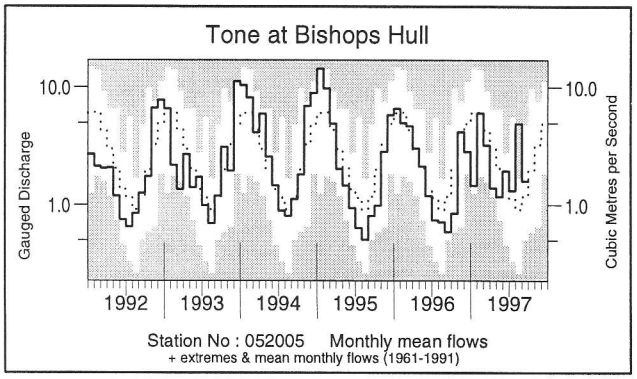
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1992 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

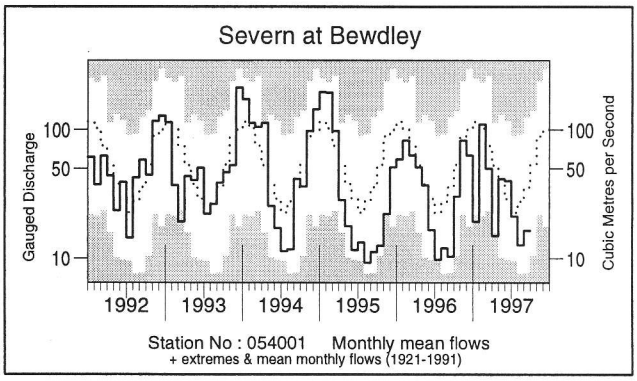
River flow . . . River flow . . .

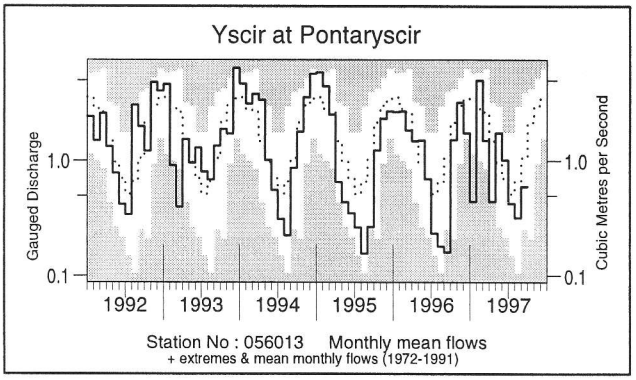


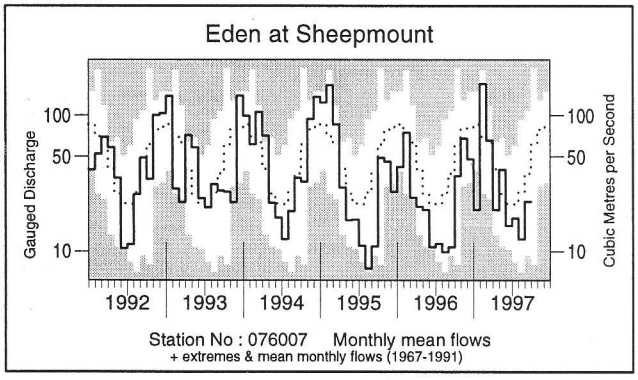


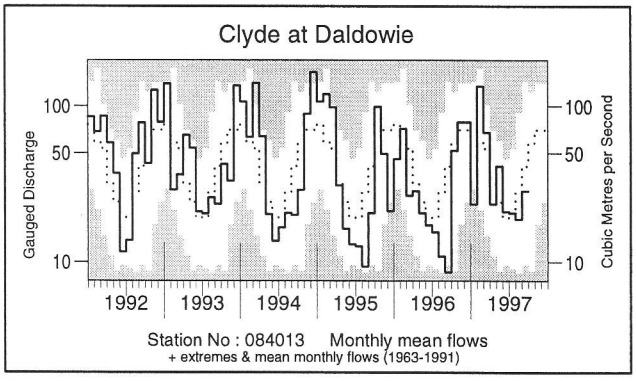










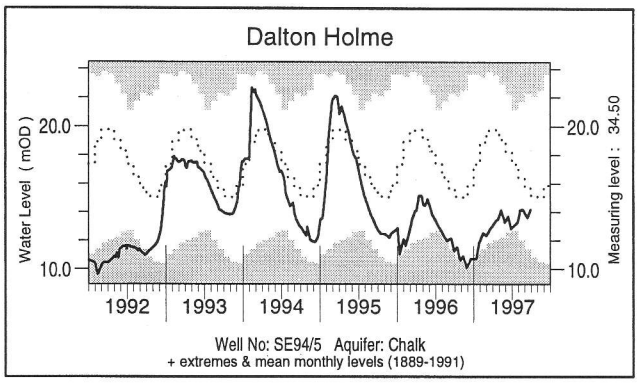


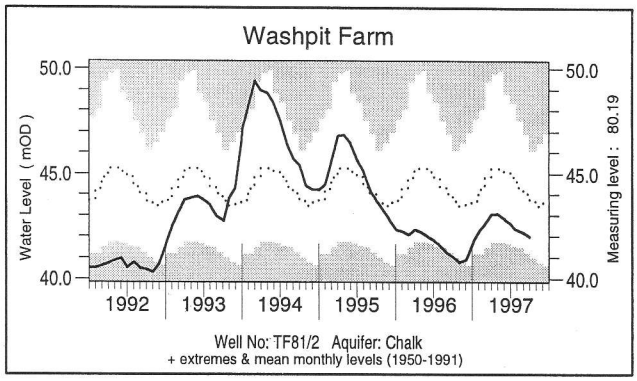
Notable runoff accumulations July - September 1997 (a); October 1995 - September 1997 (b)

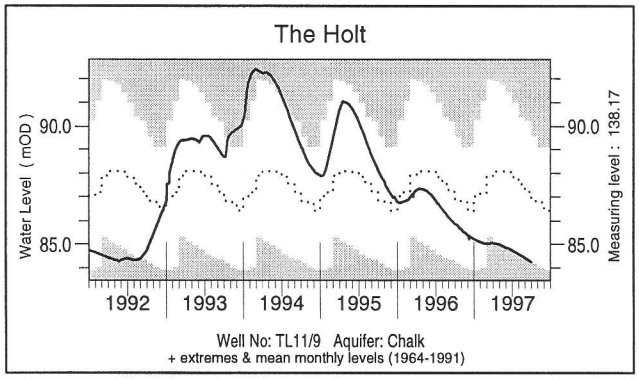
(a) River	%lta	Rank	(b) River	%lta	Rank	River	%lta	Rank
Colne	52	3/38	Wharfe	61	1/41	Ouse (Sussex)	44	1/29
Mimram	46	2/45	Trent	59	1/38	Severn	63	1/75
Kennet	57	2/36	Dove	56	1/35	Dee (Welsh)	69	1/59
Coln	65	2/34	L. Ouse	46	1/28	Lune	68	1/33
Avon	56	2/33	Medway	51	1/31			
Kenwyn	185	27/29	Taw	71	1/38			

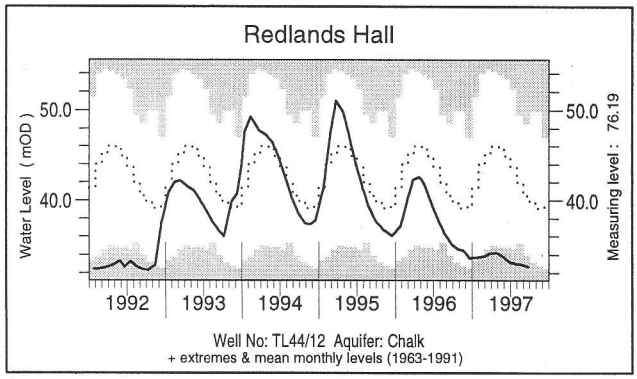
lta = long term average
Rank 1 = lowest on record

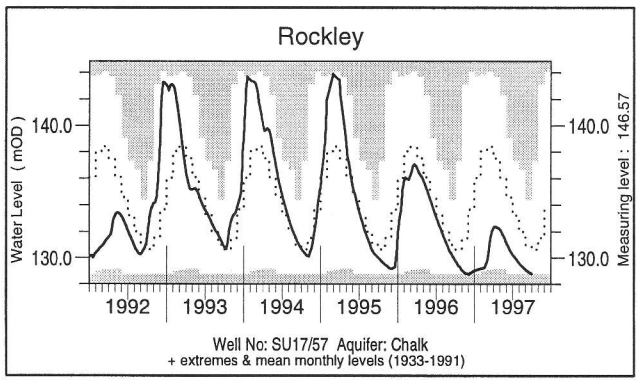
Groundwater . . . Groundwater

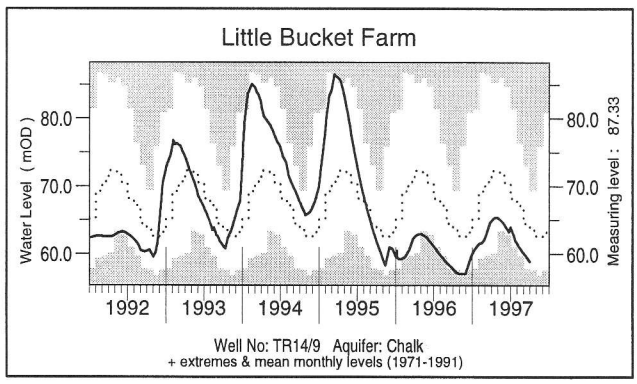


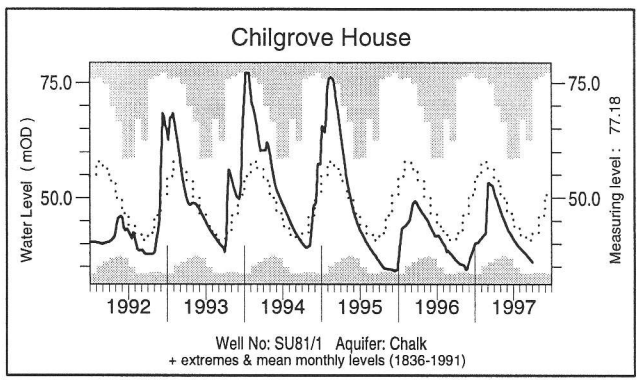


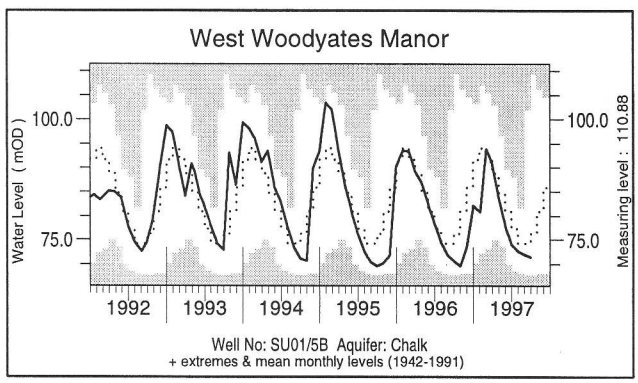








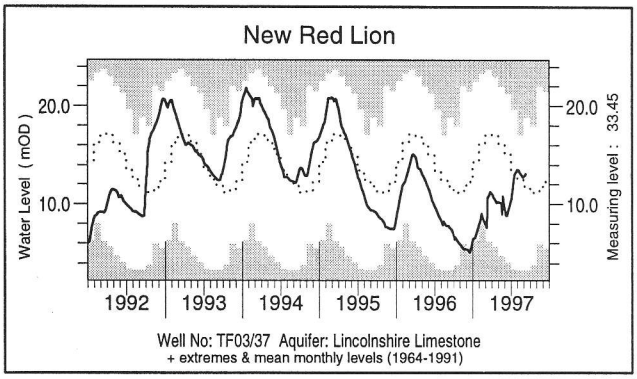


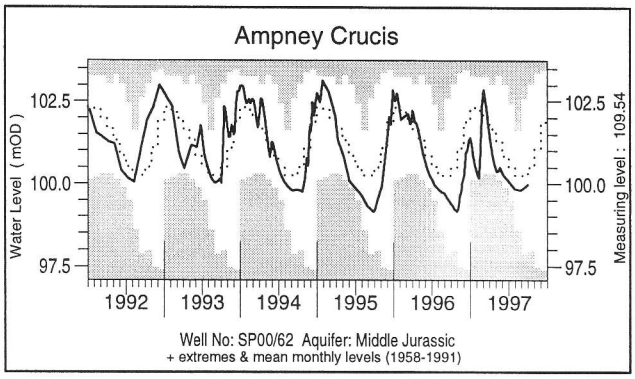


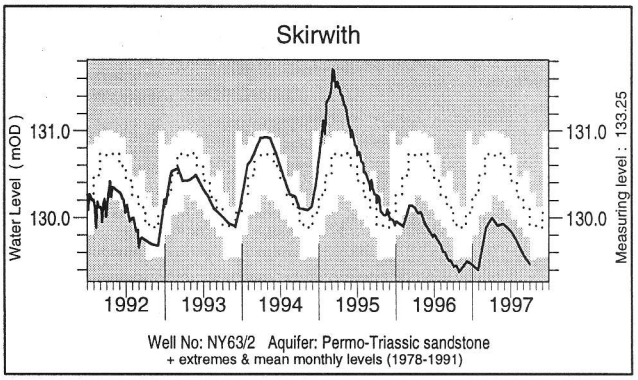
What is groundwater?

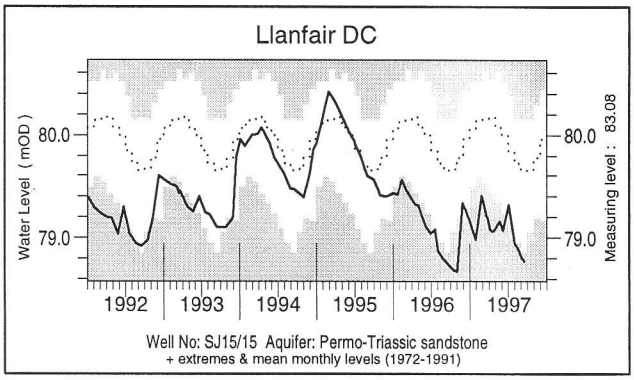
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment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

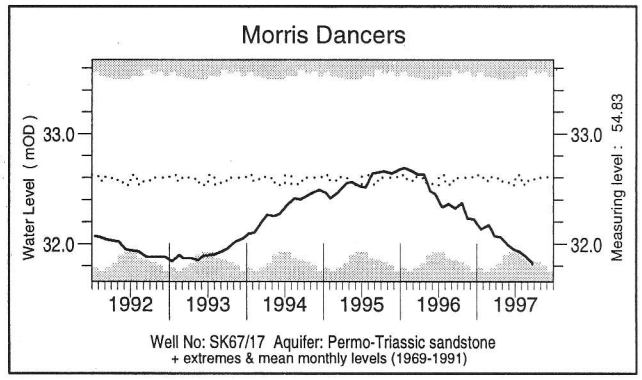
Groundwater . . . Groundwater

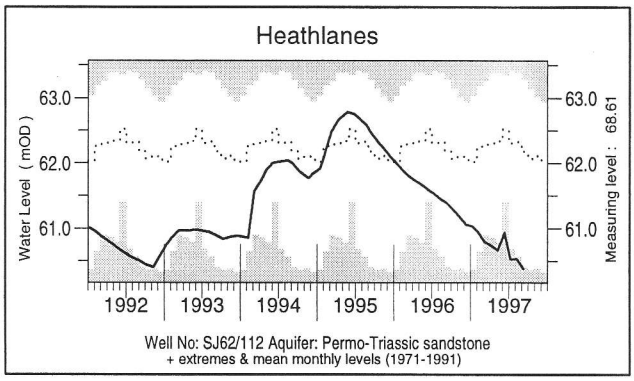


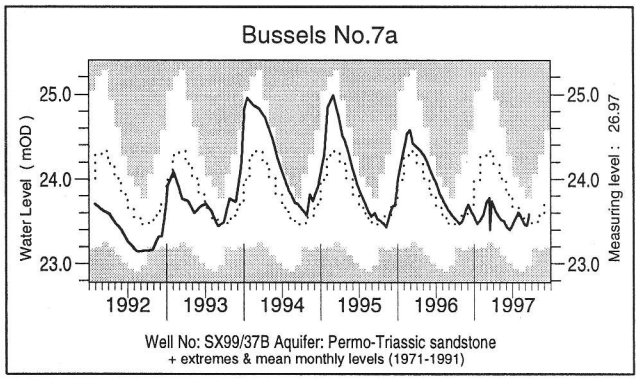


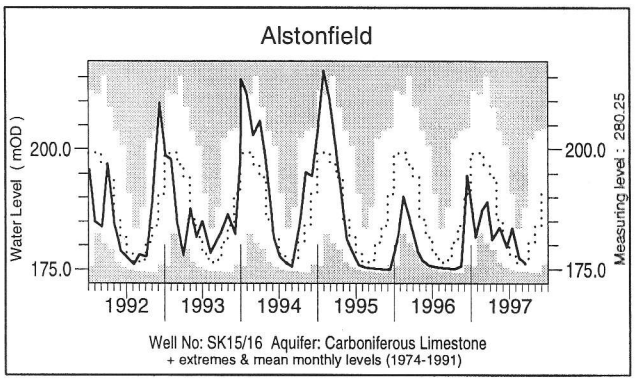












Groundwater levels September/October 1997

Borehole	Level	Date	Sep av.
Dalton Holme	14.2	26/9	15.45
Washpit Farm	42.0	1/10	43.9
The Holt	84.3	29/9	87.3
Redlands Hall	32.7	24/9	39.5
Rockley *	128.8	29/9	131.0
Little Bucket	58.9	30/9	64.4

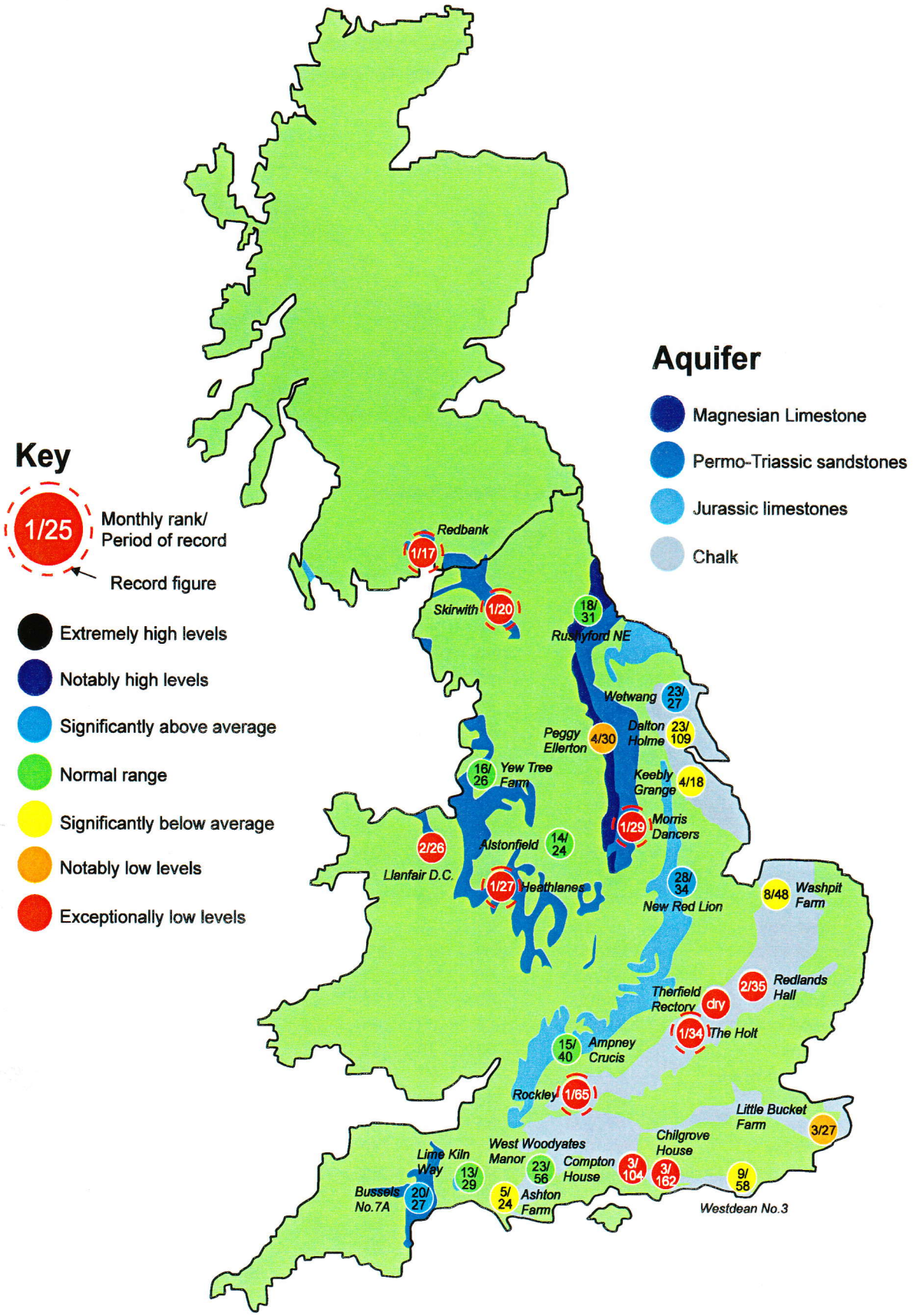
Borehole	Level	Date	Sep av.
Chilgrove	36.1	29/9	40.9
W Woodyates	71.4	30/9	73.1
New Red Lion	12.7	28/8	11.5
Ampney Crucis	99.97	29/9	100.2
Skirwith	129.5	30/9	130.1

Borehole	Level	Date	Sep av.
Llanfair DC	78.8	15/9	79.5
Morris Dancers	31.8	22/9	32.5
Heathlanes	60.4	18/9	62.0
Bussels	23.6	19/9	23.5
Alstonfield	176.2	15/9	177.1

**Data from new Rockley borehole*

Levels in metres above Ordnance Datum

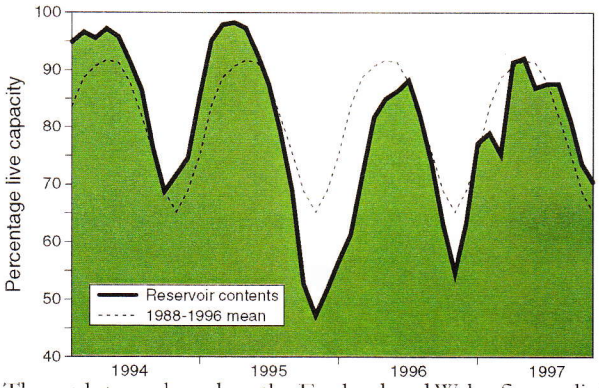
Groundwater . . . Groundwater



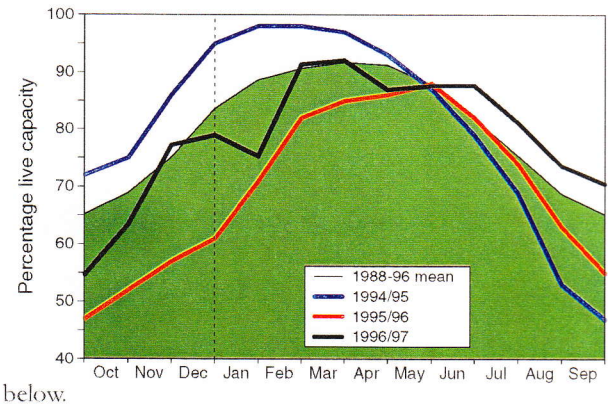
Groundwater levels - September 1997

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)	1997 May	Jun	Jul	Aug	Sep	**Oct**	Min. Oct	Year* of min
North West	N Command Zone	• 133375	87	88	78	66	53	60	13	1995
	Vyrnwy	55146	86	87	90	75	65	61	26	1995
Northumbrian	Teesdale	• 87936	89	85	87	84	74	73	31	1995
	Kielder	(199175)	(90)	(92)	(94)	(94)	(85)	(82)	(59)	1989
Severn Trent	Clywedog	44922	98	98	98	91	80	82	24	1989
	Derwent Valley	• 39525	95	98	100	90	80	72	24	1989
Yorkshire	Washburn	• 22035	86	89	99	87	77	72	24	1995
	Bradford supply	• 41407	90	95	96	87	76	76	15	1995
Anglian	Grafham	58707	73	72	70	66	59	46	46	**1997**
	Rutland	130061	72	75	75	78	76	72	61	1995
Thames	London	• 206399	93	88	88	77	67	53	53	**1997**
	Farmoor	• 13843	98	98	100	98	99	96	60	1990
Southern	Bewl	28170	91	84	79	74	65	58	32	1990
	Ardingly	4685	100	98	92	93	86	68	37	1996
Wessex	Clatworthy	5364	89	79	97	91	91	85	30	1995
	Bristol WW	• (38666)	(92)	(88)	(85)	(74)	(72)	(67)	(31)	1990
South West	Colliford	28540	56	52	51	47	43	43	43	**1997**
	Roadford	34500	60	59	58	57	56	56	26	1995
	Wimbleball	21320	84	79	84	81	84	79	30	1995
	Stithians	5205	89	79	76	66	70	70	22	1990
Welsh	Celyn and Brenig	• 131155	94	97	98	93	83	83	39	1989
	Brianne	62140	86	96	99	93	92	94	48	1995
	Big Five	• 69762	85	88	88	74	71	68	19	1995
	Elan Valley	• 99106	91	97	99	89	84	87	34	1995
East of Scotland	Edinburgh/Mid Lothian	• 97639	94	94	92	90	71	66	64	1995
	East Lothian	• 10206	98	100	100	94	80	71	52	1989
West of Scotland	Loch Katrine	• 111363	96	94	82	68	56	72	43	1995
	Daer	22412	94	94	87	74	60	73	32	1995
	Loch Thom	• 11840	94	95	77	69	58	69	56	1995

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

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 area; this can be particularly important during droughts. The minimum storage figures relate to the 1988-1997 period only.

Location map . . . Location map

Where the information comes from

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) and the Office of Water Services (OFWAT).

River flow and groundwater levels

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.

River flow and groundwater level data are provided by the regional divisions of the EA (England and Wales) and SEPA (Scotland). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

Reservoirs

Reservoir level information is provided by the Water Service Companies, the EA and, in Scotland, the West of Scotland and East of Scotland Water Authorities.

Rainfall

Most rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data are presented for the regional divisions of the precursor organisations of the EA and SEPA. The recent rainfall estimates for the Scottish regions are derived by IH in collaboration with the SEPA regions. In England and Wales the recent 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 provisional regional rainfall figures are regularly updated using figures derived from a much denser rainguage network. Further details of Met. Office services can be obtained from:

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

The cooperation of all data suppliers is gratefully acknowledged.

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