Hydrological summary *for Great Britain*

July 1997

General

July was a moderately warm, generally sunny but unsettled month. Longer term rainfall deficiencies increased in some eastern and southern areas but several damp interludes usefully restrained the normal summer surge in water demand. Stocks in some lowland reservoirs are low (eg Grafham) but overall are appreciably above average for the late summer. In contrast, groundwater levels remain very depressed over wide areas, causing a continuing failure of springs and notably low flows in many lowland rivers. With average late summer and autumn rainfall the seasonal upturn in runoff and recharge rates should begin within the normal timeframe but substantial winter rainfall - and a prolonged recharge season - will be required to restore groundwater levels to the average by the spring of 1998.

Rainfall

The very unsettled conditions which characterised June continued into July. North-eastern Scotland was especially wet early in the month - a slow moving low pressure system producing exceptional 48-hour rainfall totals (80-100 mm) along the coastal fringe to the south of the Moray Firth. High pressure began to dominate weather patterns thereafter and a brief heatwave was experienced early in the second week, the hot and humid conditions triggered thunderstorms - mostly in southern Britain. Subsequently frontal systems began to penetrate from the west producing more extensive rainfall although storm totals were very modest in the east. For Britain as a whole the provisional July rainfall total was around 90% of average and most regions were within the normal range - but the thundery weather made for large local differences in monthly totals. Drought intensity again declined in some of the affected regions but overall the rainfall deficiency remains exceptional. Only during the 1988-92 drought (and then marginally) have lower 28-month accumulations for E&W been registered in the last 140 years. Over shorter timeframes the picture is more encouraging: regional rainfall totals over the last 3, 6 and 12 months are all within the normal range albeit well below average over the last year in much of the English lowlands, the Thames Valley especially.

River Flow

July opened with a very notable flood in north east Scotland. After two days of continuous rainfall - totals reaching 150 mm at Relugas (south of Forres), the rivers Nairn, Divie, Lossie and Isla all registered new maximum recorded flows. Flooding, mostly generated in the lower catchments, was extensive from Inverness to Macduff; over 1200 people were evacuated and disruption to industry, agriculture and transport was severe. Several episodes of very localised flooding triggered by thunderstorms were reported at intervals in the south. July runoff totals were above average throughout much of Scotland and in the normal range in Wales, northern England and the South-West. By contrast, seasonal recessions became firmly re-established in most of lowland England; with baseflow contributions now very meagre, July runoff was close to the lowest on record in some permeable catchments (eg the Mimram and Kennet). On the Thames and Hampshire Avon, the July runoff total was the third lowest for almost 50 years - although still well above the 1976 and 1934 minima. The hydrological impact of the long term rainfall deficiency is evident over the longer timeframes: two-year runoff totals (for periods ending in July) are the lowest on record for many rivers (including the Trent, Medway, Exe and Welsh Dee).

Groundwater

Recharge amounts in July were, as usual, very meagre and throughout most major aquifers recessions continued - gently in the east where natural base levels are being approached in many areas. In the western and northern Permo-Triassic sandstones levels remain very low but the wet late spring/early summer has left water-tables above, or similar to, corresponding levels in 1996. The same is true of much of the Carboniferous, Lincolnshires and Oolitic limestones outcrops where modest July increases in levels were reported for some index wells. In the Chalk however levels are depressed throughout the aquifer - particularly in the South-East and parts of East Anglia (eg the Suffolk Chalk) - but generally levels are a little above the 1976 minima (often 1992 also). The contrast with levels in early 1995 is remarkable and the range of water-table variation over the last decade has very few modern parallels. Soil moisture deficits are now lower than in the late summer for most recent years over much of the drought affected region but the 1997 seasonal recoveries in groundwater levels will need to be generated from an exceptionally low base.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall. .

Rainfall accumulations and return period estimates

Area	Rainfall	Jul 1997	May 97-Jul 97	RP	Dec 96-Jul 97	RP	Aug 96-Jul 97	RP	Apr 95-Jul 97	RP
England & Wales	**mm**	**55**	**260**		**503**		**836**		**1691**	
	%	**88**	**136**	**10-15**	**89**	**2-5**	**93**	**2-5**	**83**	**35-50**
NorthWest	mm	80	284		687		1128		2110	
	%	94	118	2-5	94	2-5	94	2-5	78	120-170
Northumbrian	mm	71	281		571		848		1732	
	%	109	150	20-35	106	2-5	99	2-5	89	5-10
SevernTrent	mm	47	244		447		701		1419	
	%	89	143	10-20	92	2-5	93	2-5	82	30-50
Yorkshire	mm	71	299		563		838		1554	
	%	120	167	50-80	107	2-5	102	2-5	83	30-45
Anglian	mm	50	217		347		577		1107	
	%	102	146	10-20	90	2-5	97	2-5	80	40-60
Thames	mm	38	187		327		563		1255	
	%	77	117	2-5	74	10-20	82	5-10	79	35-50
Southern	mm	32	204		377		690		1419	
	%	67	131	5-10	77	5-10	89	2-5	80	30-50
Wessex	mm	34	194		405		753		1734	
	%	65	114	2-5	75	5-15	90	2-5	91	2-5
SouthWest	mm	37	243		552		1038		2316	
	%	53	116	2-5	73	10-20	88	2-5	88	5-10
Welsh	mm	61	308		671		1182		2471	
	%	79	129	5-10	82	5-10	90	2-5	84	20-35
Scotland	**mm**	**101**	**315**		**945**		**1496**		**3036**	
	%	**108**	**118**	**5-10**	**108**	**2-5**	**104**	**2-5**	**94**	**2-5**
Highland	mm	96	321		1171		1847		3561	
	%	91	108	2-5	110	2-5	105	2-5	91	5-10
North East	mm	84	330		679		1024		2338	
	%	115	158	60-90	113	5-10	105	2-5	106	2-5
Tay	mm	70	289		785		1242		2677	
	%	90	124	5-10	102	2-5	101	2-5	97	2-5
Forth	mm	63	283		755		1187		2358	
	%	84	130	5-10	111	2-5	107	2-5	95	2-5
Tweed	mm	68	299		705		1067		2113	
	%	93	143	15-25	117	5-10	110	2-5	96	2-5
Solway	mm	98	319		848		1395		2910	
	%	109	123	5-10	99	2-5	98	2-5	92	5-10
Clyde	mm	87	241		970		1618		3384	
	%	80	82	2-5	96	2-5	95	2-5	90	5-15

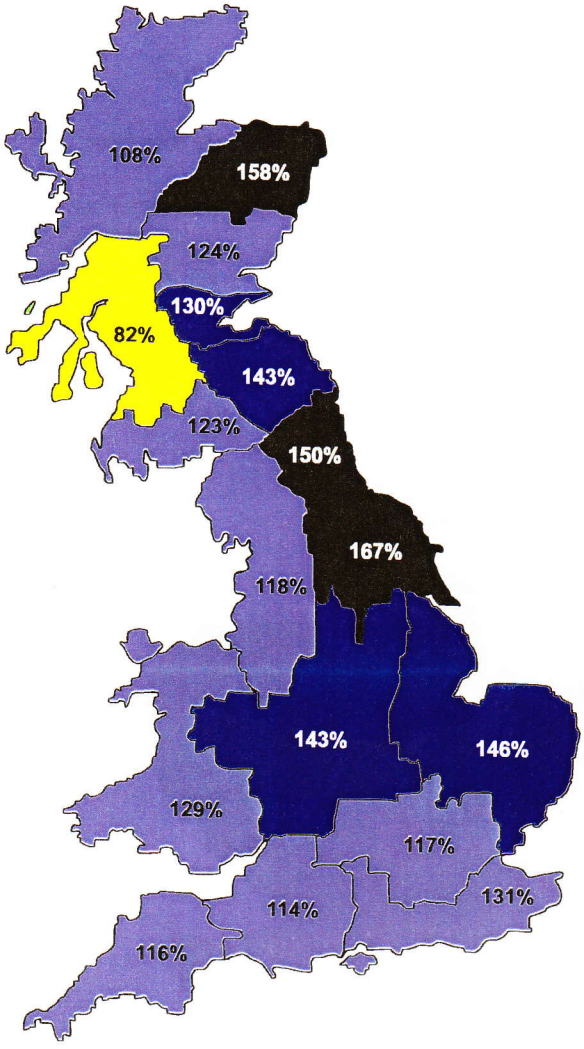
RP = Return period

 The table shows the actual rainfall (mm) for four periods with the corresponding percentage (%) based on the 1961-1990 average, and the estimated return period in years (the longer the return period the more unusual the event). 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. The tables reflect rainfall over the period 1911-70 and assume a stable climate.

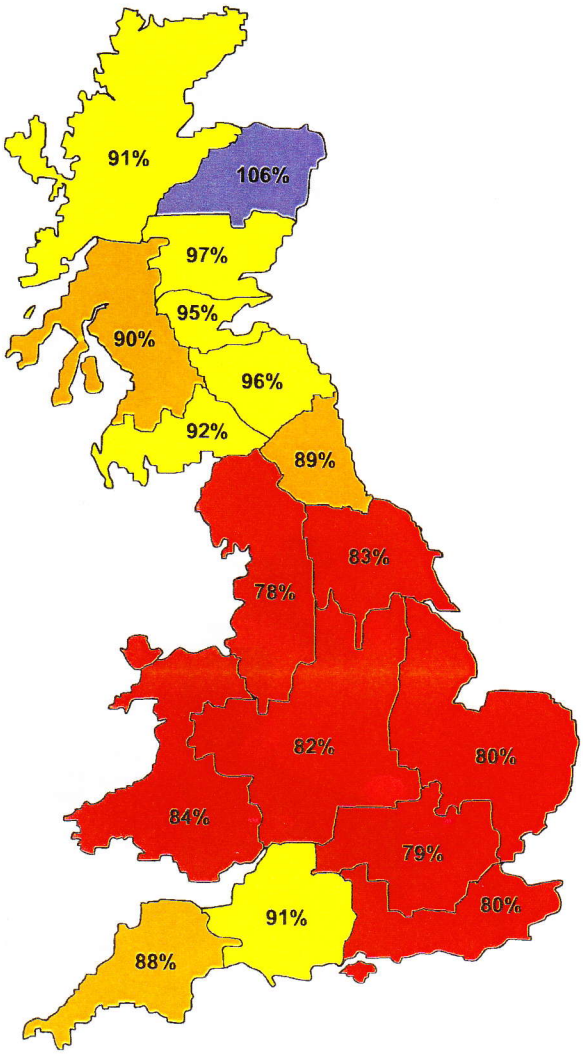
Rainfall . . . Rainfall . . . Rainfall

Key

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



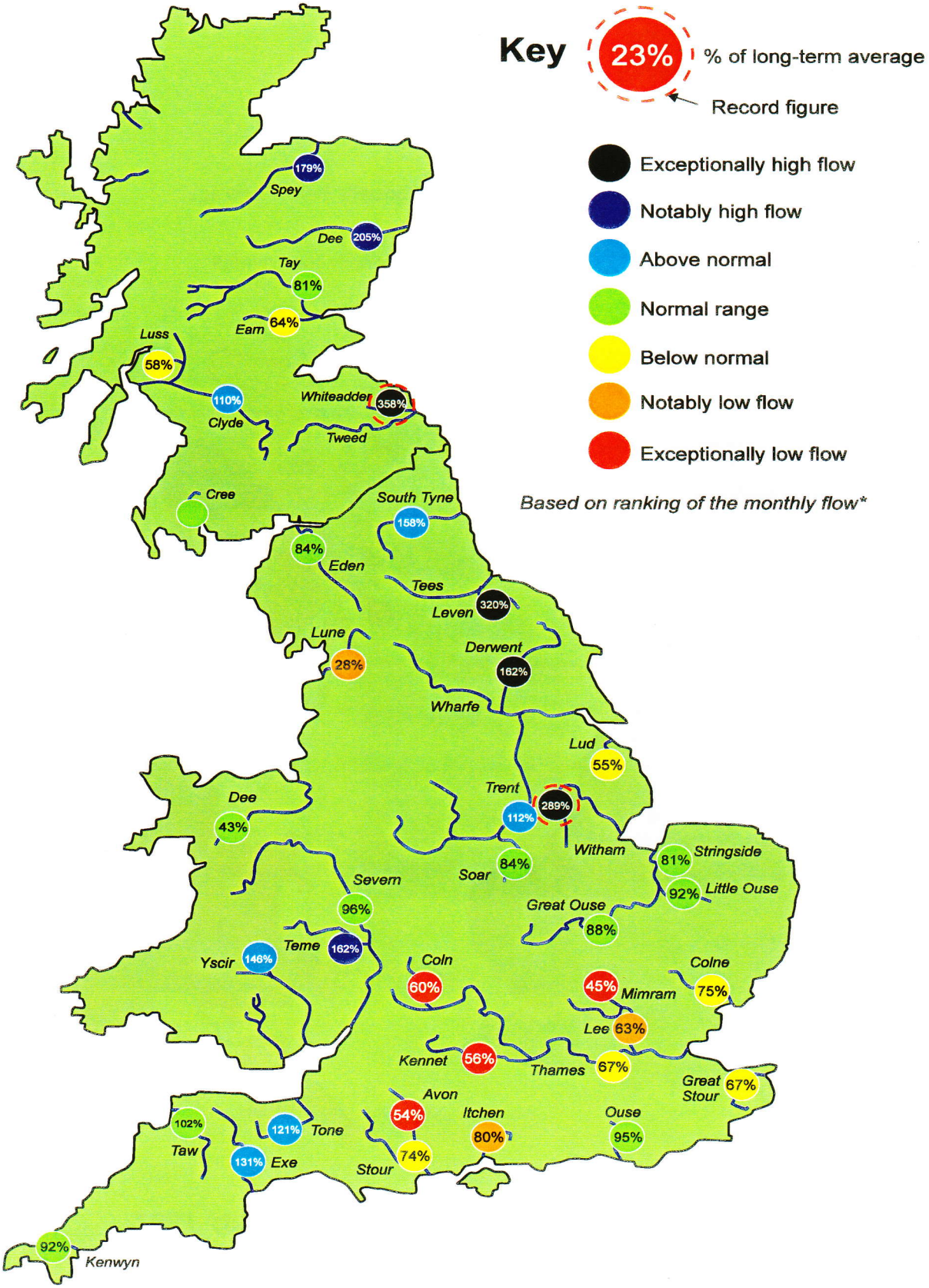
May 1997 - July 1997



April 1995 - July 1997

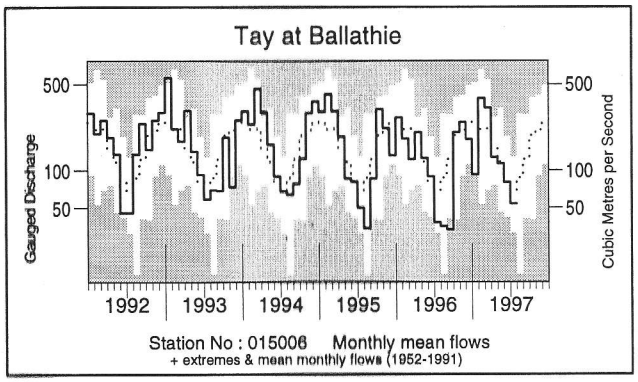
Rainfall accumulation maps

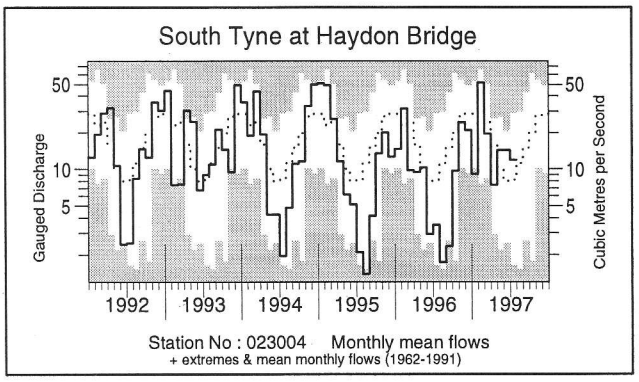
The regional rainfall maps present a picture that has become familiar over the last decade: above average recent rainfall combined with a continuing long term deficiency. The provisional May-July rainfall total for Great Britain is the highest for 30 years but the rainfall deficiencies in England for the period since March 1995 remain the equivalent of around 5-6 months average rainfall over wide areas.

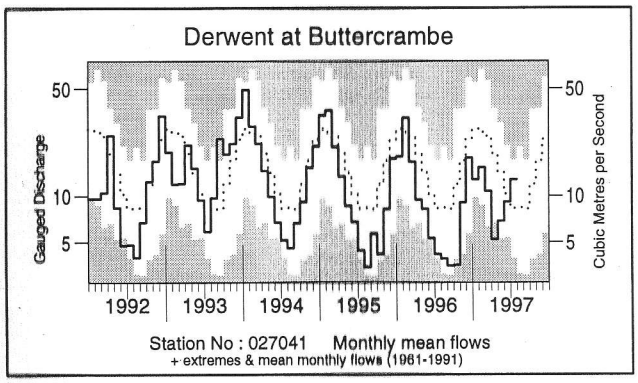


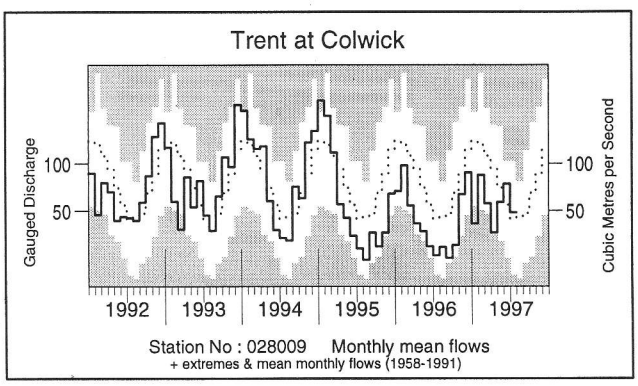
River flows - July 1997

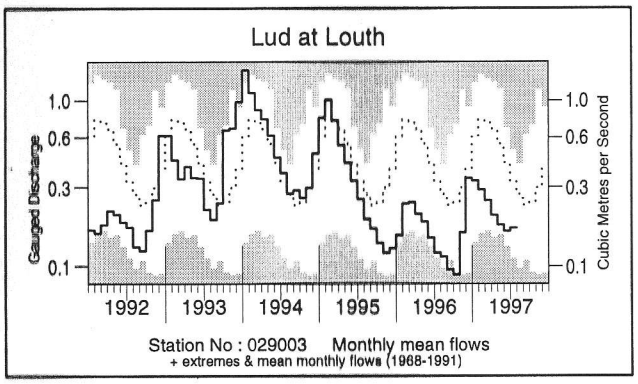
Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

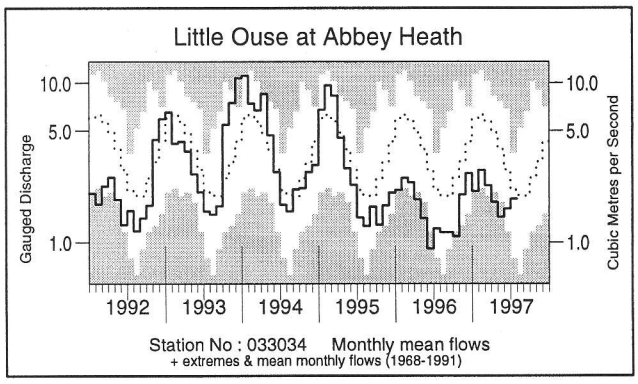


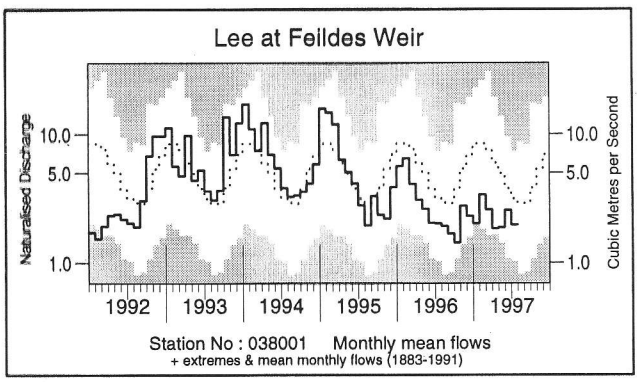


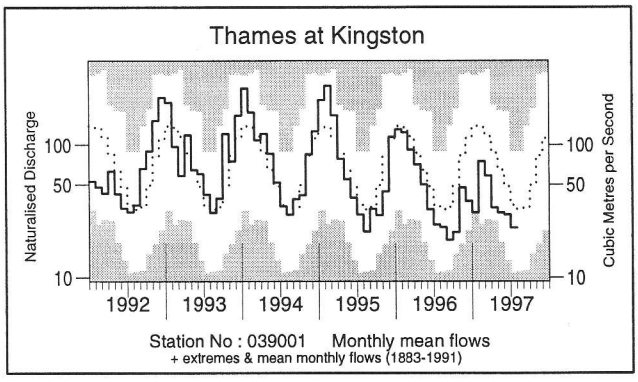








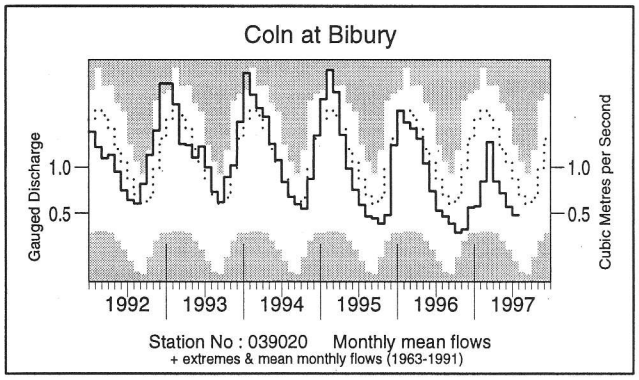


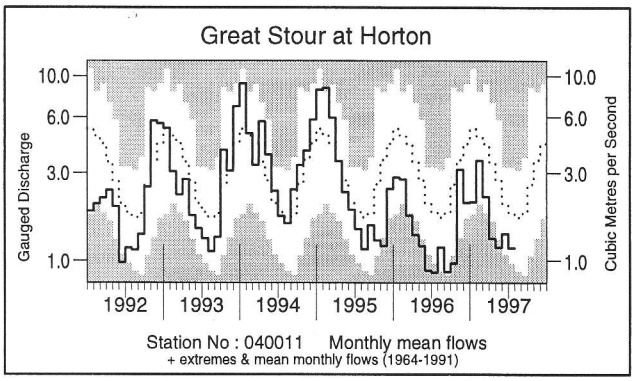


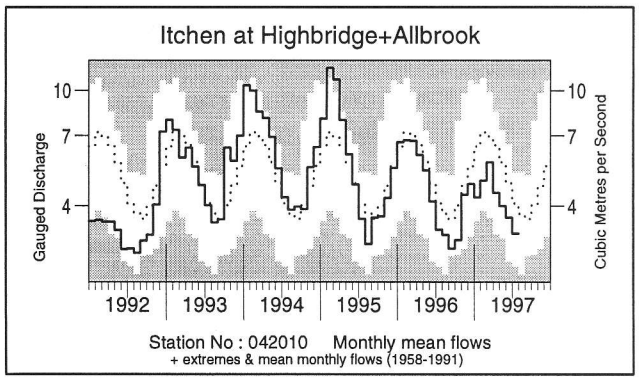
Monthly river flow hydrographs

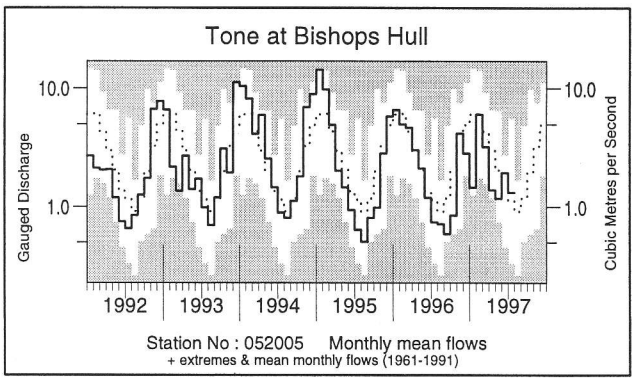
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1992 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

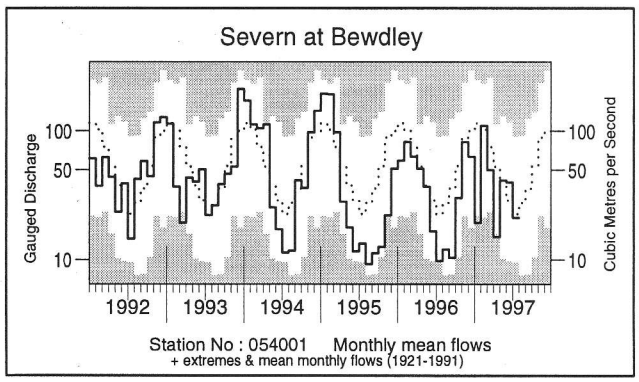
River flow . . . River flow . . .

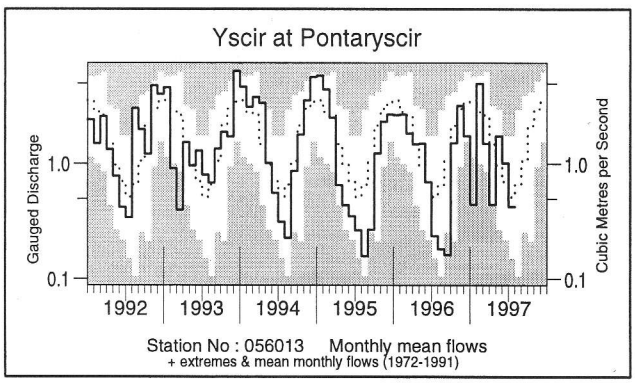


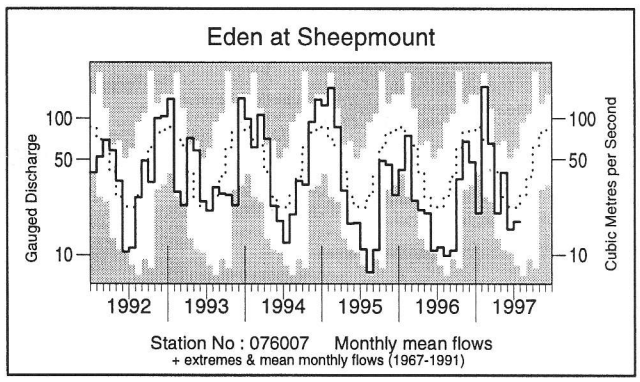


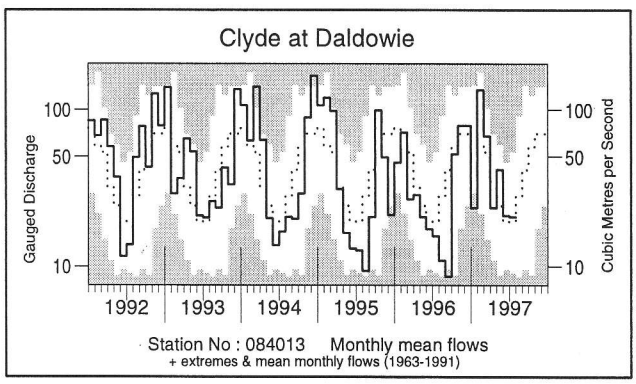










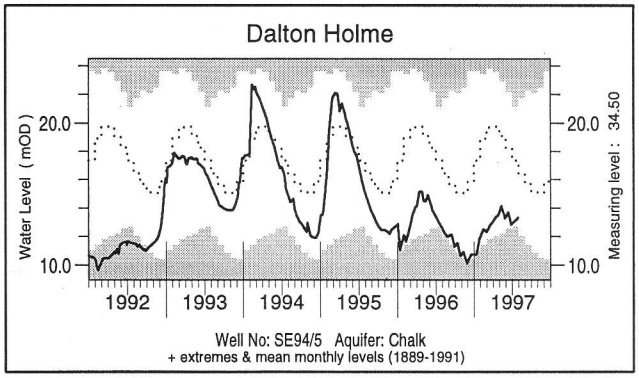


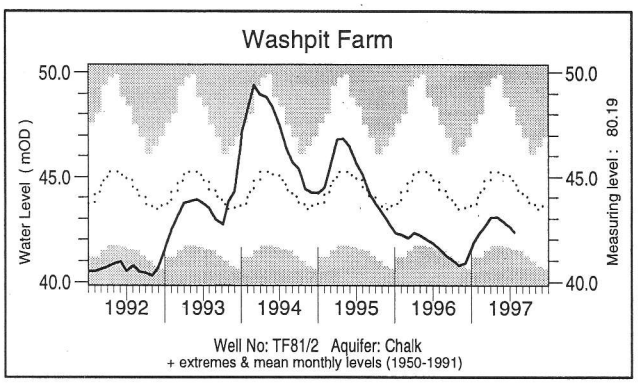
Notable runoff accumulations May - July 1997 (a); August 1995 - July 1997 (b)

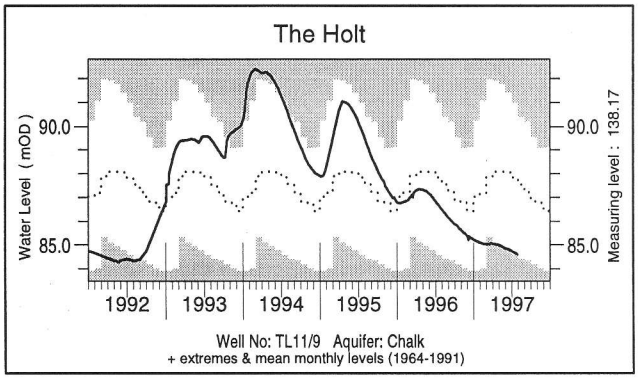
(a) River	%lta	Rank	(b) River	%lta	Rank	River	%lta	Rank
Whiteadder	181	27/28	S. Tyne	71	1/30	Coln	65	1/32
S. Tyne	159	31/34	Wharfe	59	1/40	Medway	51	1/30
Leven	175	33/37	Trent	58	1/37	Exe	75	1/40
Mimram	44	2/45	Dove	55	1/34	Taw	68	1/37
Coln	55	2/34	Soar	52	1/25	Dee (Welsh)	69	1/58
Avon (Hants)	52	2/33	Coln	65	1/32			

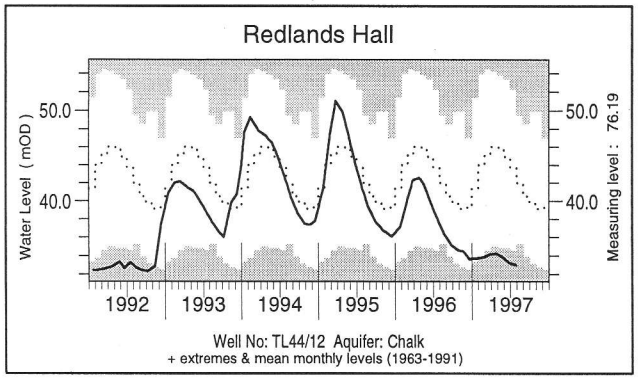
lta = long term average
Rank 1 = lowest on record

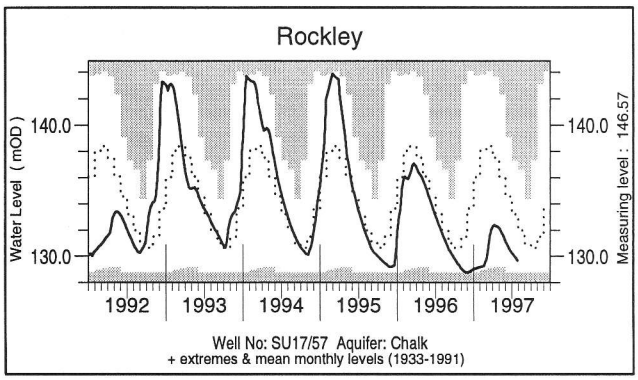
Groundwater . . . Groundwater

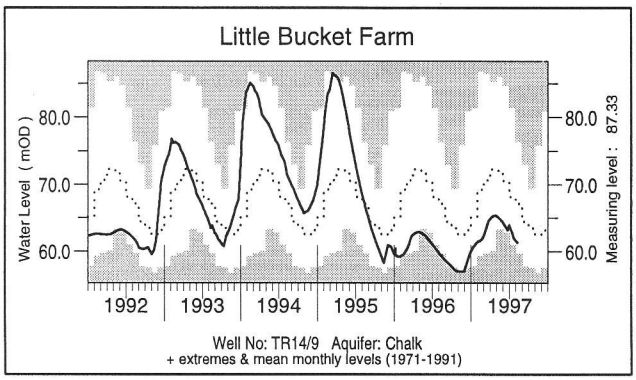


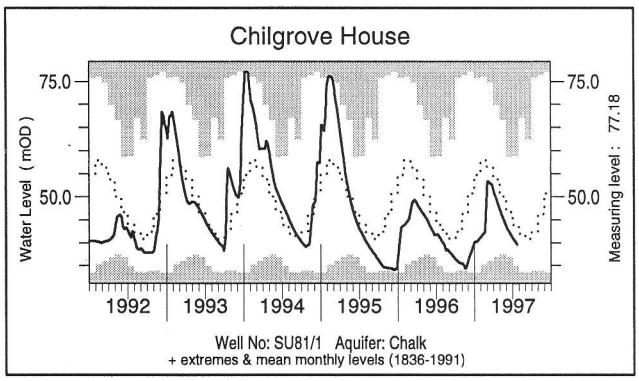


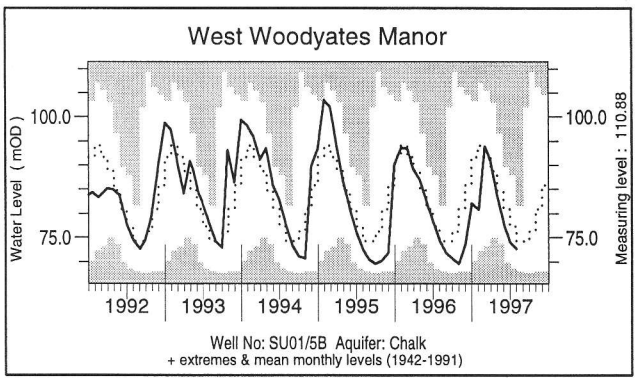








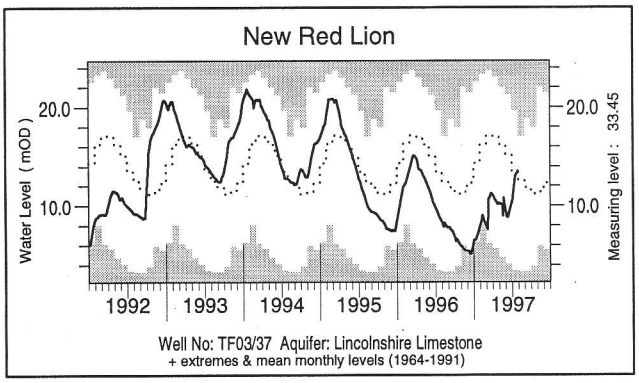


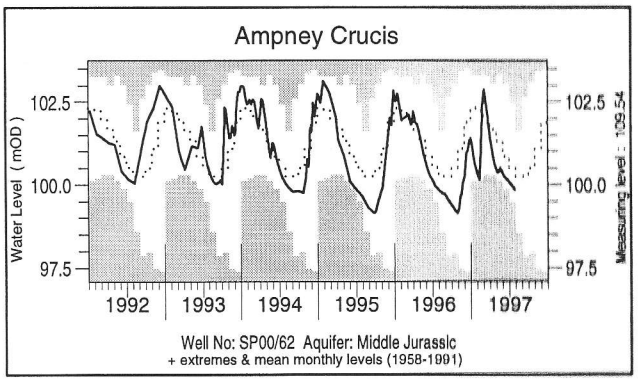


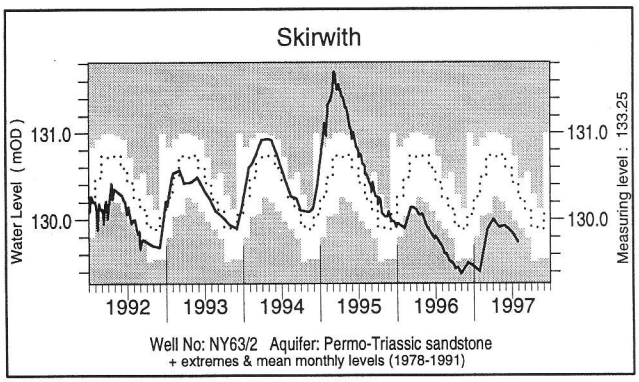
What is groundwater?

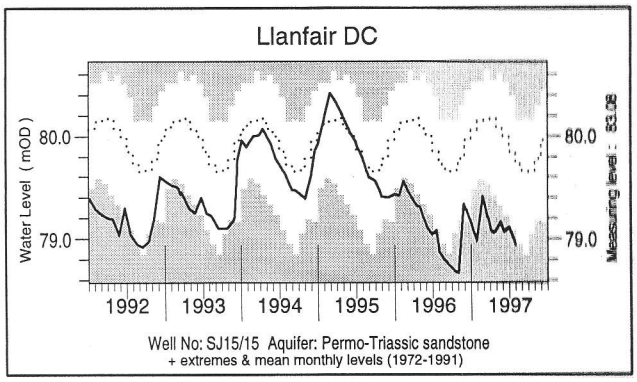
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment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

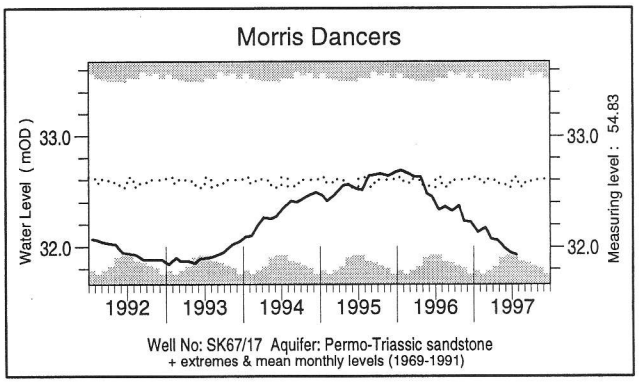
Groundwater . . . Groundwater

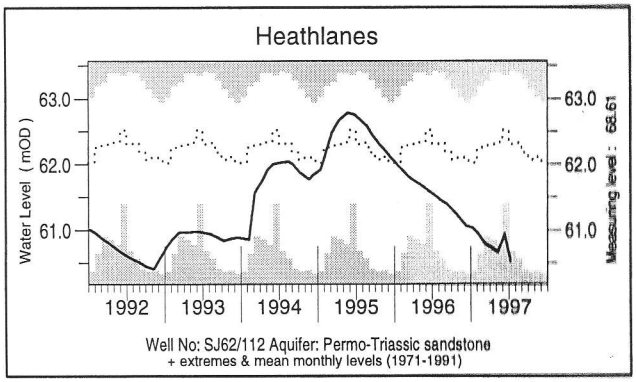


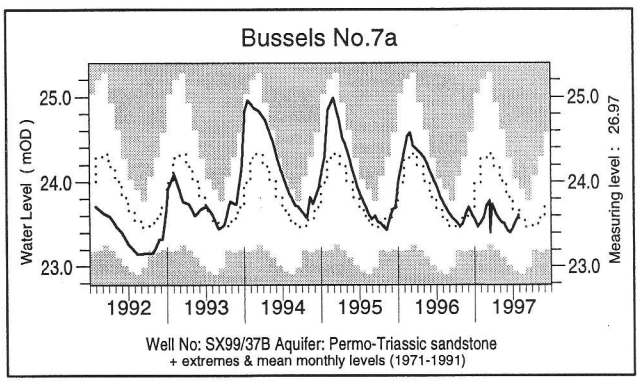


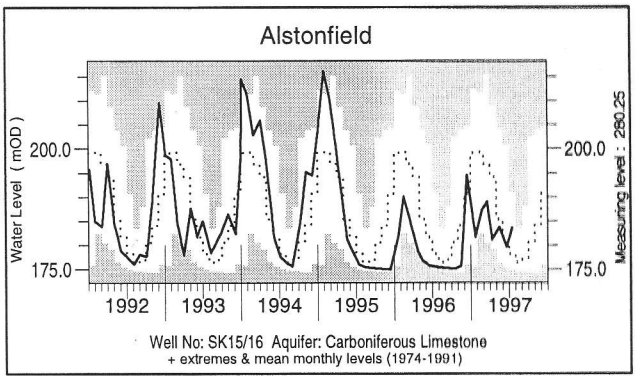












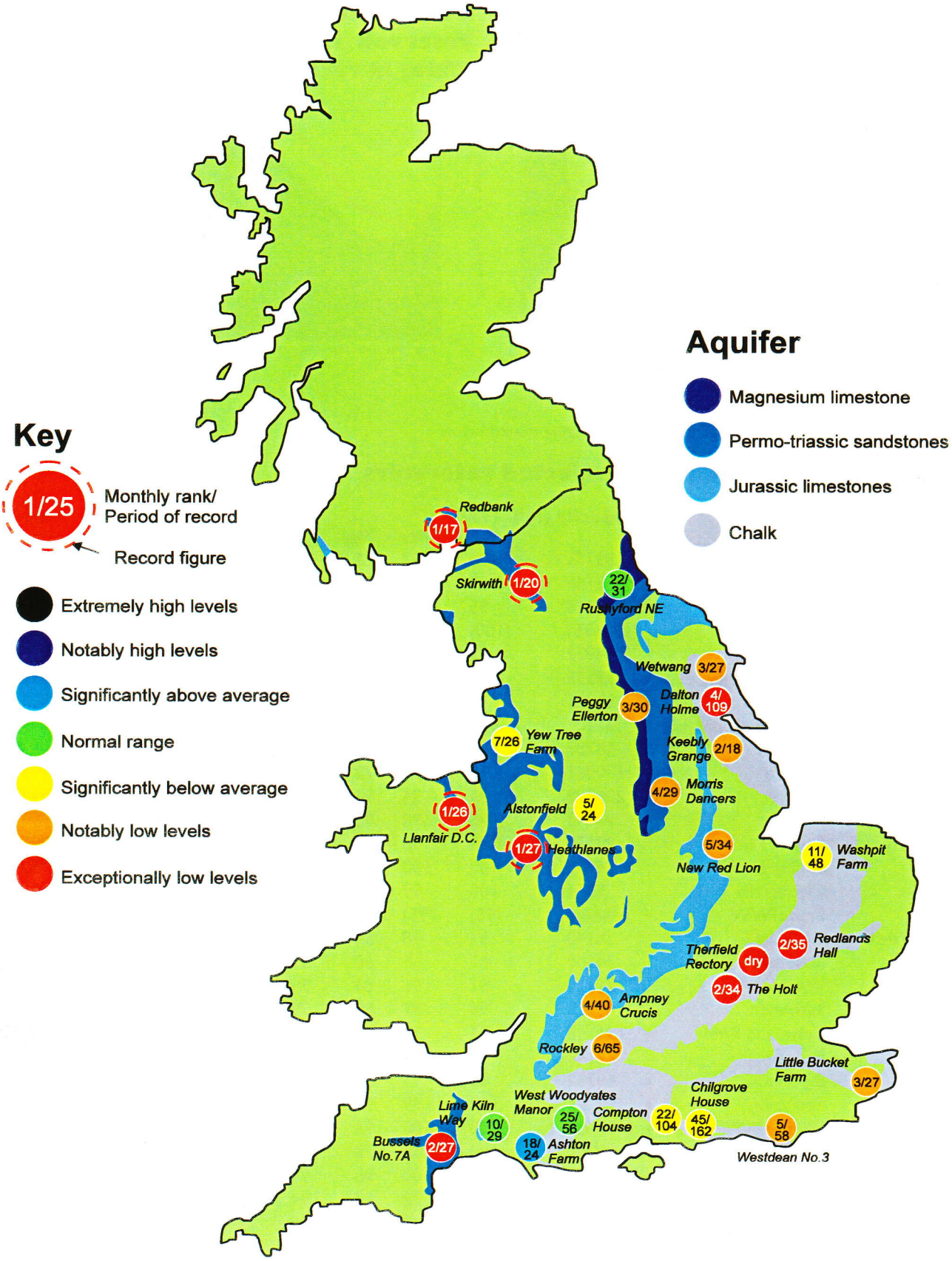
Groundwater levels July/August 1997

Borehole	Level	Date	July av.
Dalton Holme	13.3	28/7	17.17
Washpit Farm	42.35	23/7	44.70
The Holt	84.6	28/7	88.02
Redlands Hall	33.01	27/7	42.41
Rockley	129.7	28/7	133.13
Little Bucket	61.3	8/7	68.19

Borehole	Level	Date	July av.
Chilgrove	39.54	23/7	43.56
W Woodyates	72.62	31/7	76.87
New Red Lion	13.5	29/7	3.42
Ampney Crucis	99.85	28/7	100.47
Skirwith	129.7	29/7	130.27

Borehole	Level	Date	July av.
Llanfair DC	78.95	30/7	79.67
Morris Dancers	31.93	21/7	32.47
Heathlanes	60.53	8/7	62.18
Bussels	23.61	29/7	23.69
Alstonfield	183.52	15/7	178.61

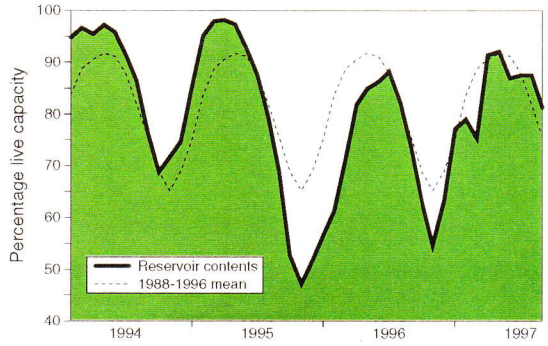
Levels in metres above Ordnance Datum



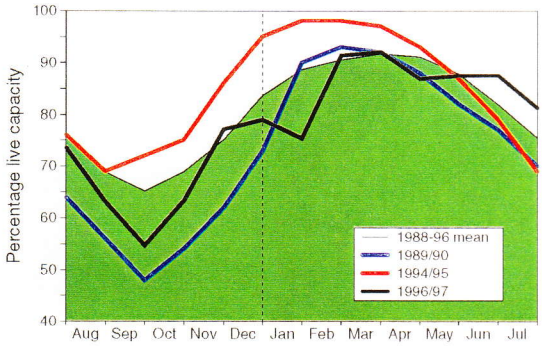
Groundwater levels - July 1997

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 Mar	Apr	May	Jun	Jul	**Aug**	Min. Aug	Year of min
North West	N Command Zone	•	133375	100	97	87	88	78	**66**	38	1989
	Vyrnwy		55146	100	95	86	87	90	**75**	56	1996
Northumbrian	Teesdale	•	87936	95	97	89	85	87	**84**	45	1989
	Kielder		(199175)	(100)	(93)	(90)	(92)	(94)	**(94)**	(66)	1989
Severn Trent	Clywedog		44922	93	97	98	98	98	**91**	57	1989
	Derwent Valley	•	39525	100	100	95	98	100	**90**	43	1996
Yorkshire	Washburn	•	22035	98	93	86	89	99	**87**	50	1995
	Bradford supply	•	41407	100	98	90	95	96	**87**	38	1995
Anglian	Grafham		58707	72	77	73	72	70	**66**	66	**1997**
	Rutland		130061	73	76	72	75	75	**78**	74	1995
Thames	London	•	206399	85	94	93	88	88	**77**	73	1990
	Farmoor	•	13843	96	98	98	98	100	**98**	84	1990
Southern	Bewl		28170	85	98	91	84	79	**74**	45	1990
	Ardingly		4685	100	100	100	98	92	**93**	66	1995
Wessex	Clatworthy		5364	100	99	89	79	97	**91**	43	1992
	Bristol WW	•	(38666)	(96)	(95)	(92)	(88)	(85)	**(74)**	(53)	1990
South West	Colliford		28540	57	58	56	52	51	**47**	47	**1997**
	Roadford		34500	61	62	60	59	58	**57**	46	1996
	Wimbleball		21320	81	91	84	79	84	**81**	53	1992
	Stithians		5205	96	97	89	79	76	**66**	39	1990
Welsh	Celyn and Bren	•	131155	97	98	94	97	98	**93**	65	1989
	Brianne		62140	99	97	86	96	99	**93**	67	1995
	Big Five	•	69762	96	95	85	88	88	**74**	41	1989
	Elan Valley	•	99106	100	99	91	97	99	**89**	63	1989
East of Scotland	Edinburgh/Mid	•	97639	100	100	94	94	92	**90**	62	1989
	East Lothian	•	10206	100	99	98	100	100	**94**	72	1992
West of Scotland	Loch Katrine	•	111363	100	100	96	94	82	**68**	68	**1997**
	Daer		22412	100	98	94	94	87	**74**	58	1994
	Loch Thom	•	11840	100	100	94	95	77	**69**	69	**1997**

( ) 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 (DoE), 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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