Hydrological summary

for Great Britain

August 1997

General

Nationally, August provided an unusual combination of sunny conditions, notably high temperatures and above average rainfall. Rainfall totals were, again, above average in most drought affected regions but - as is usual in the late summer - they served to moderate demand rather than significantly increasing water resources. Overall reservoir contents remain healthy but stocks are substantially below average in several major lowland reservoirs (eg Grafham). More significantly, groundwater levels - and flows in many spring-fed rivers - remain depressed over wide areas. The summer rainfall has been very welcome but, in hydrological terms, the drought remains severe in large parts of eastern, central and southern England (and a few more northerly areas). The current wet phase will need to continue through the autumn and winter to generate sustained recoveries in runoff and recharge rates.

Rainfall

August was characterised by substantial regional and local variability in rainfall amounts. Heat wave conditions in mid-month were associated with prolonged dry interludes in many areas but weather patterns were more unsettled early and late in the month - when a westerly airflow brought an autumnal complexion to the weather. August regional rainfall totals were below average in northern Britain - considerably so in parts of southern Scotland, but appreciably above average for England and Wales as a whole - parts of southern England registered more than twice the August mean and thunderstorms produced some intensive downpours (including 68 mm in 5 hours at Burstow, near Gatwick on the 6th and 38 mm in < 1 hour at Shanklin IOW on the 25th). There were, however, pockets of well below average August rainfall in the east (eg in Hertfordshire and Essex). For E&W rainfall was above average for the fourth successive month and the provisional summer (Jun-Aug) total was the highest for 40 years - almost 50% greater than the average for the last 10 years. Notwithstanding the recent easing of the drought, long term rainfall deficiencies remain notable: in the last 140 years only during the 1988-92 drought have lower 29-month accumulations been recorded than the April 1995-August 1997 total. Regionally, the deficiencies are most significant in the South-East, East Anglia, parts of the Midlands and the North-West.

River Flow

Flow rates in August showed wide spatial and temporal variability: monthly mean flows were relatively low in most of northern Britain but above average throughout much of Wales and the South-West where a number of new maximum August runoff totals were established (eg on the Otter, Kenwyn and most notably, the Tone. Above average runoff was also registered in a significant proportion of impervious lowland catchments. Localised flooding was mostly associated with thunderstorms (eg on the Tone which exceeded its previous peak August flow by a wide margin on the 6th; in central Scotland on the 14th, and in a number of mostly urban catchments, eg in Sheffield and London, around month-end). Commonly in the lowlands, minor spate conditions in impermeable catchments were juxtaposed with exceptionally low river flows in streams reliant principally on groundwater. The Little Ouse, Mimram, Kennet, Coln and Hampshire Avon each recorded their second lowest August flow (after 1976) on record and drainage networks continue to contract. Rivers registering new minimum 24-month runoff totals (for periods ending in August) show a wide distribution, and account for about a quarter of the index stations in the national network.

Groundwater

The late August rainfall eliminated soil moisture deficits in large parts of western Britain and infiltration began in some minor aquifers. Patchy infitration also occurred in the east - eg in the North Downs where the summer has been notably wet - triggering some very early, but localised, seasonal recoveries. Contrasting conditions in individual aquifer units limit the scope for generalisation but late August groundwater levels in the Carboniferous, Jurassic and Lincolnshire Limestones were mostly within the normal range. Upturns in the Permo -Triassic sandstones of the South-West have also occurred but levels remain close to,or below, the long term minima (for September) in a number of the more northerly outcrops (the North-West especially). In the Chalk, levels are relatively close to the seasonal average in the westerly and northerly extremities of the outcrop but the resources position is much poorer in the bulk of the eastern Chalk - where soils remain dry at depth. Levels are close to drought minima in a zone from Hertfordshire to Norfolk. In such areas average rainfall will need to be sustained over about the next 10 weeks before seasonal recoveries gather any momentum.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall. .

Rainfall accumulations and return period estimates

Area	Rainfall	Aug 1997	Jun 97-Aug 97	RP	Jan 97-Aug 97	RP	Sep 96-Aug 97	RP	Apr 95-Aug 97	RP
England & Wales	**mm**	**106**	**279**		**540**		**847**		**1782**	
	%	**140**	**138**	**10-20**	**98**	**2-5**	**95**	**2-5**	**84**	**30-40**
NorthWest	mm	71	248		675		1096		2166	
	%	67	91	2-5	95	2-5	91	2-5	77	>200
Northumbrian	mm	56	287		562		862		1813	
	%	69	139	10-15	105	2-5	101	2-5	89	5-10
SevernTrent	mm	87	260		486		726		1512	
	%	129	145	10-20	102	2-5	96	2-5	84	20-30
Yorkshire	mm	73	272		507		805		1595	
	%	98	141	10-20	98	2-5	98	2-5	82	35-50
Anglian	mm	61	234		370		567		1173	
	%	111	151	20-30	97	2-5	95	2-5	81	35-50
Thames	mm	83	218		388		587		1340	
	%	144	135	5-10	90	2-5	85	5-10	81	30-40
Southern	mm	98	245		432		697		1506	
	%	172	154	20-30	93	2-5	90	2-5	83	20-30
Wessex	mm	141	270		521		814		1881	
	%	213	154	20-30	102	2-5	97	2-5	96	2-5
SouthWest	mm	178	344		689		1129		2505	
	%	212	155	25-40	98	2-5	96	2-5	92	2-5
Welsh	mm	153	342		756		1217		2609	
	%	152	133	5-10	99	2-5	93	2-5	86	10-20
Scotland	**mm**	**52**	**245**		**888**		**1469**		**3076**	
	%	**44**	**82**	**2-5**	**106**	**2-5**	**102**	**2-5**	**92**	**5-10**
Highland	mm	62	268		1126		1836		3623	
	%	49	81	2-5	114	5-10	104	2-5	90	10-15
North East	mm	46	253		648		1017		2395	
	%	53	112	2-5	109	2-5	105	2-5	104	2-5
Tay	mm	38	216		754		1218		2717	
	%	40	89	2-5	102	2-5	99	2-5	95	2-5
Forth	mm	34	218		697		1153		2385	
	%	36	92	2-5	105	2-5	104	2-5	92	5-10
Tweed	mm	33	252		645		1063		2172	
	%	38	112	2-5	108	2-5	110	2-5	95	2-5
Solway	mm	61	246		790		1377		2958	
	%	51	84	2-5	95	2-5	97	2-5	90	5-10
Clyde	mm	55	226		944		1622		3454	
	%	41	67	10-20	98	2-5	96	2-5	88	10-20

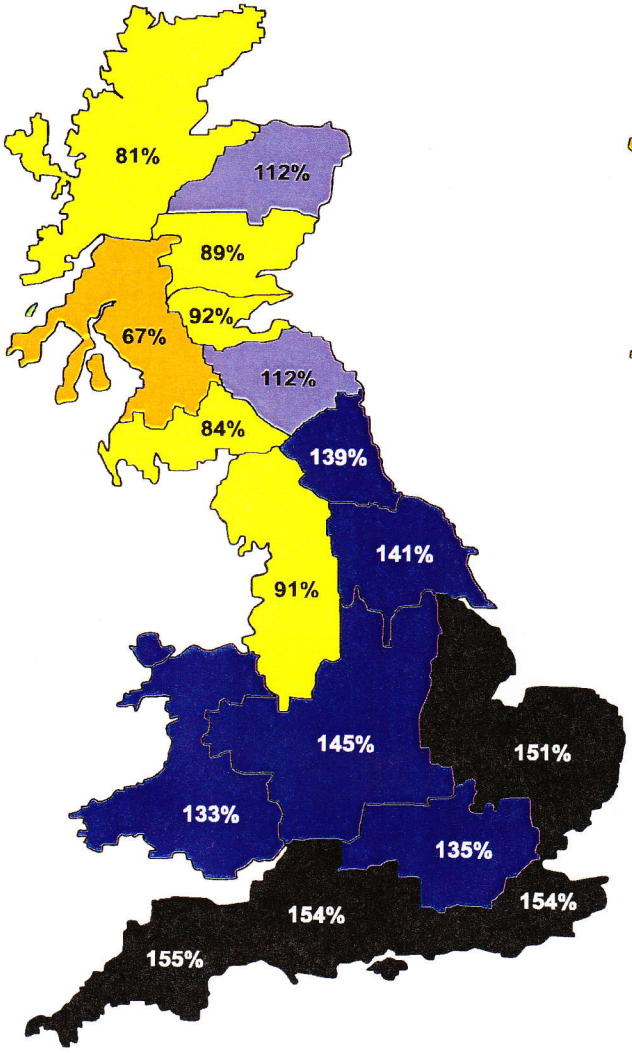
RP = Return period

 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.

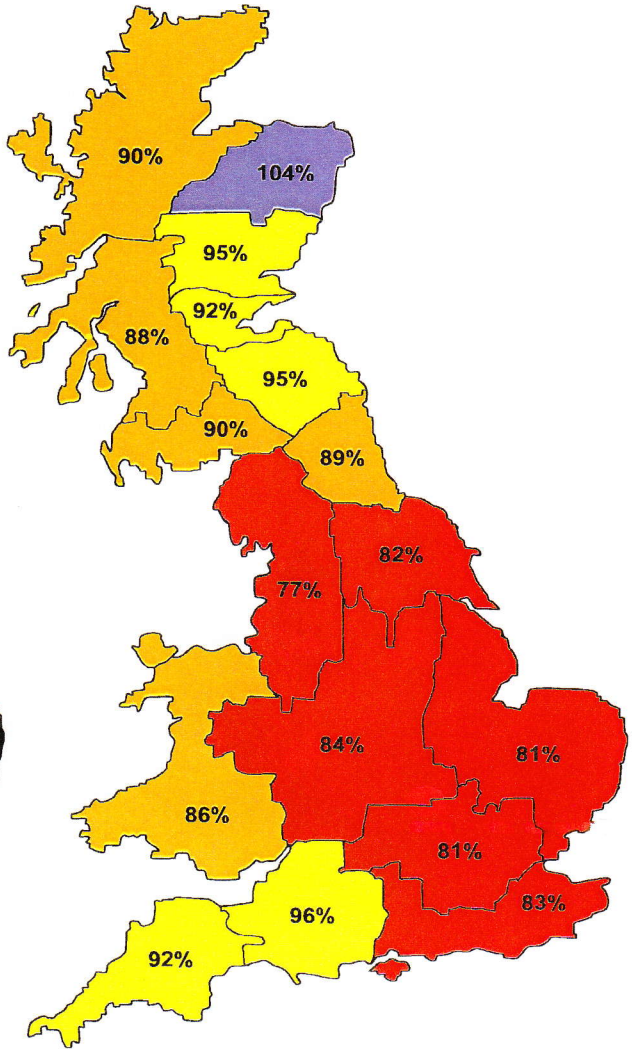
Rainfall . . . Rainfall . . . Rainfall

Key

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



June 1997 - August 1997

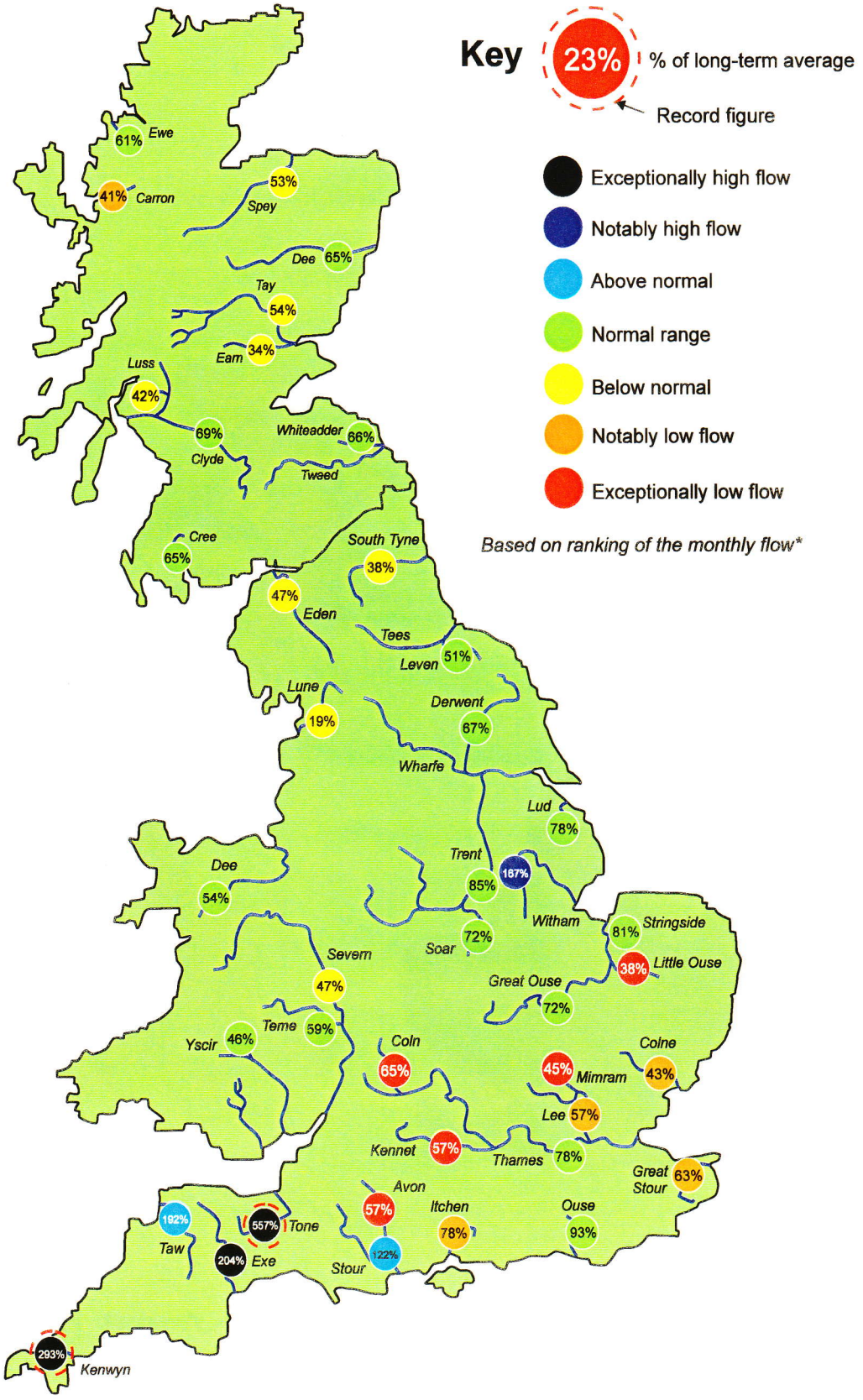


April 1995 - August 1997

Rainfall accumulation maps

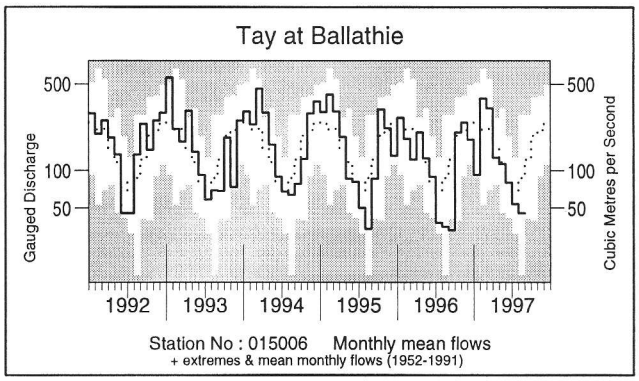
As in July, the regional rainfall maps present a familiar combination of short-term surplus and long deficiency. The provisional June-August rainfall total for England and Wales is the highest since 1958 but throughout much of England deficiencies since March 1995 remain the equivalent of around 5-6 months average rainfall.

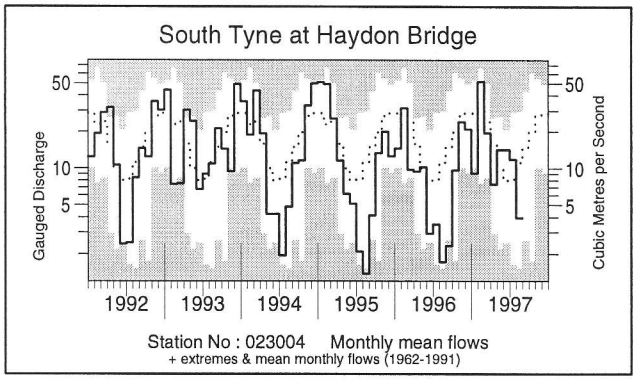
River flow . . . River flow . . .

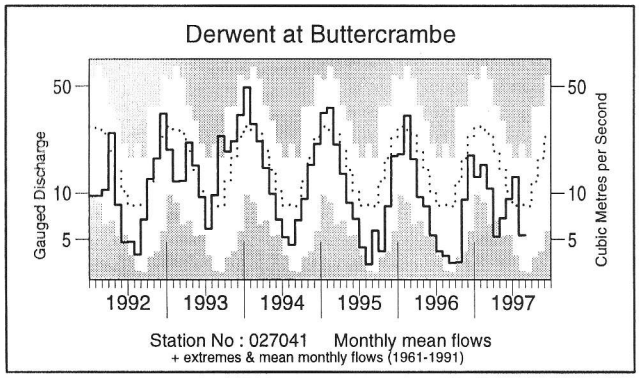


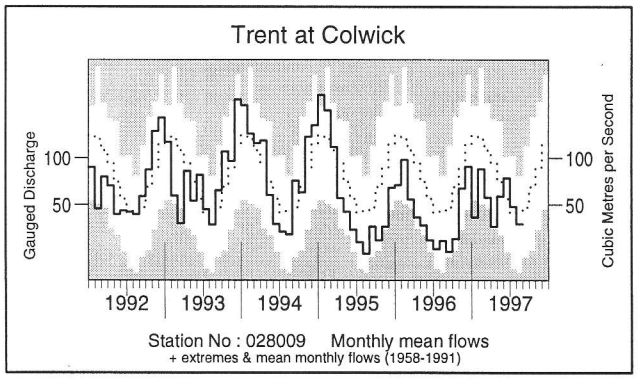
River flows - August 1997

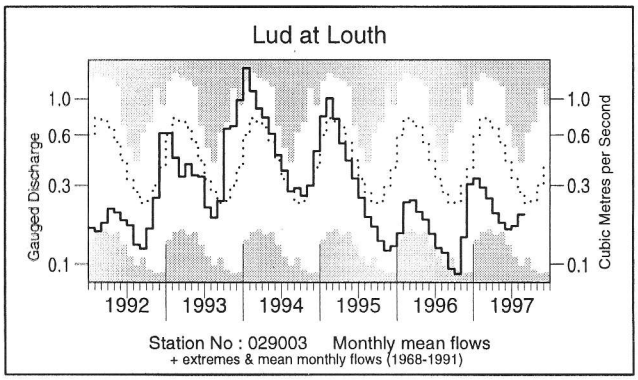
Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

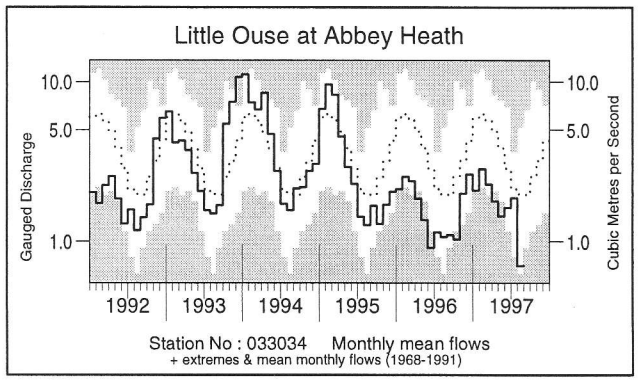


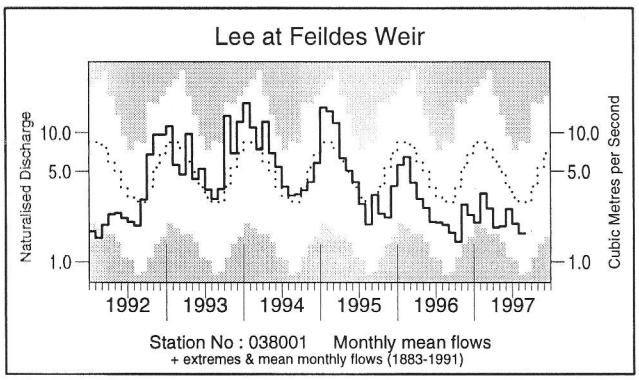


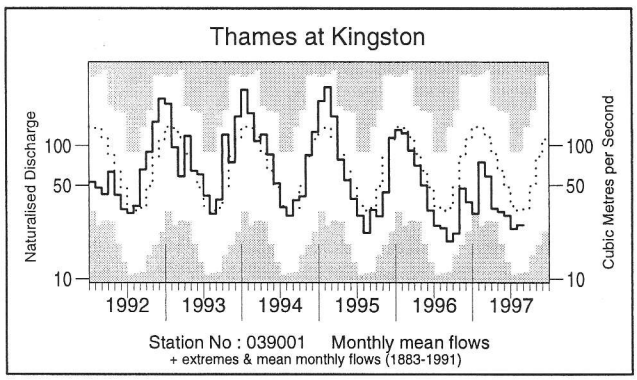








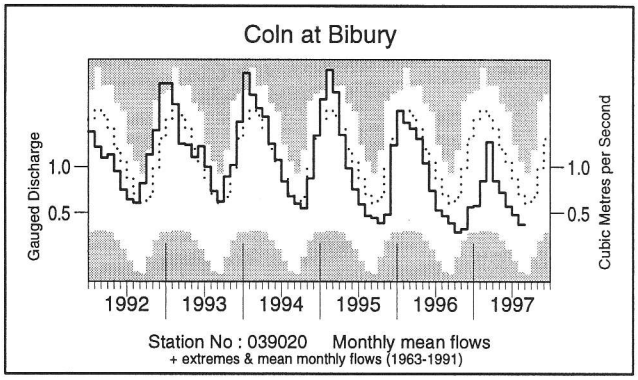


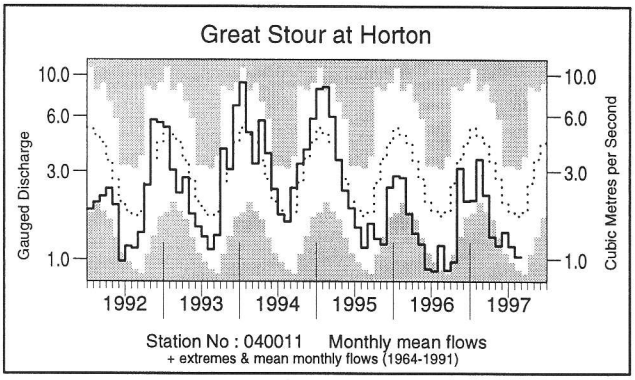


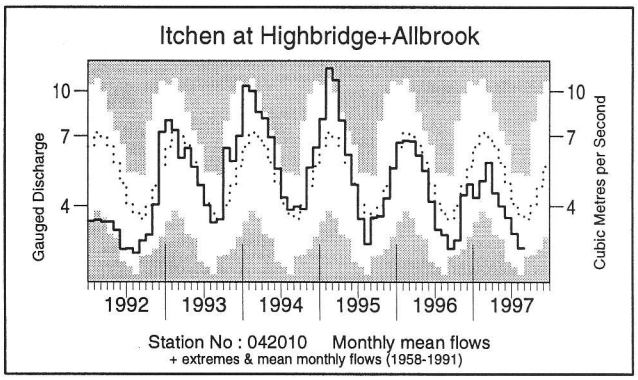
Monthly river flow hydrographs

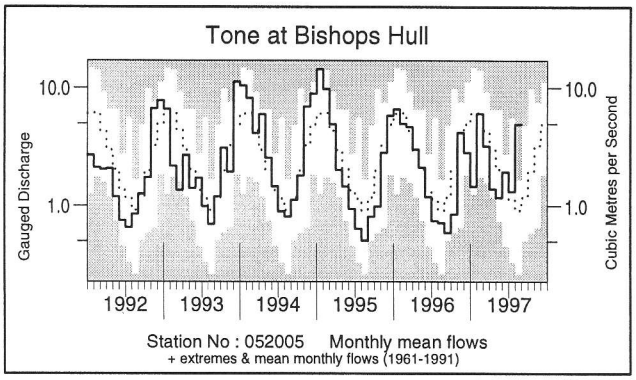
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1992 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

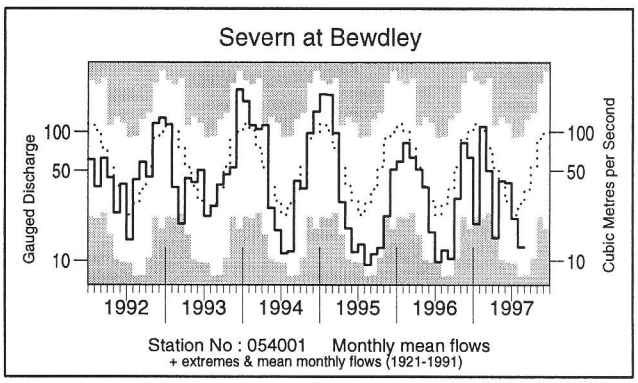
River flow . . . River flow . . .

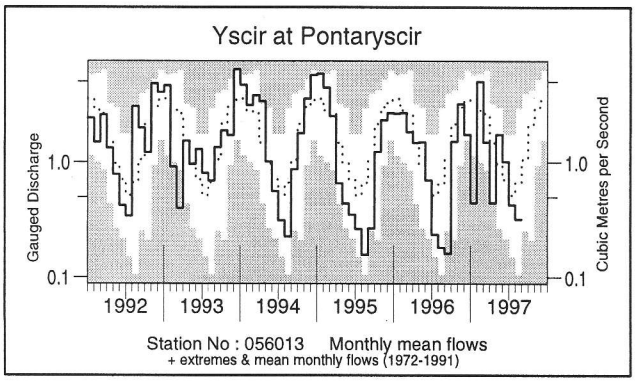


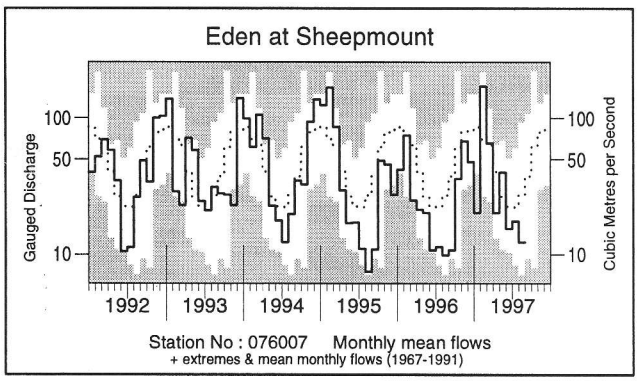


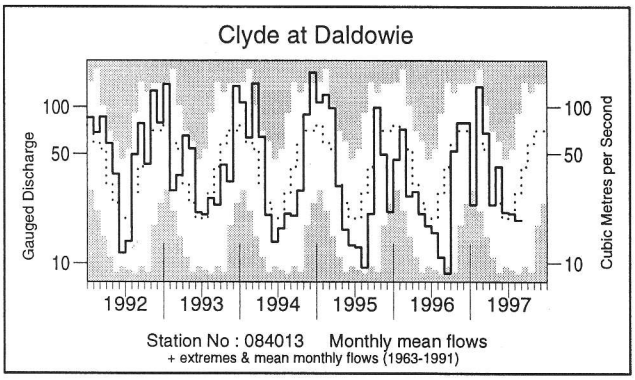












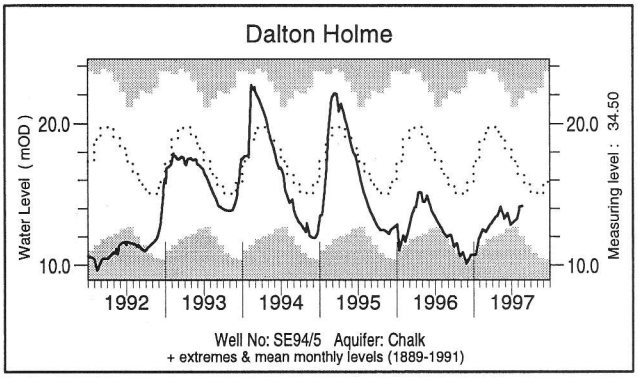
Notable runoff accumulations June - August 1997 (a); September 1995 - August 1997 (b)

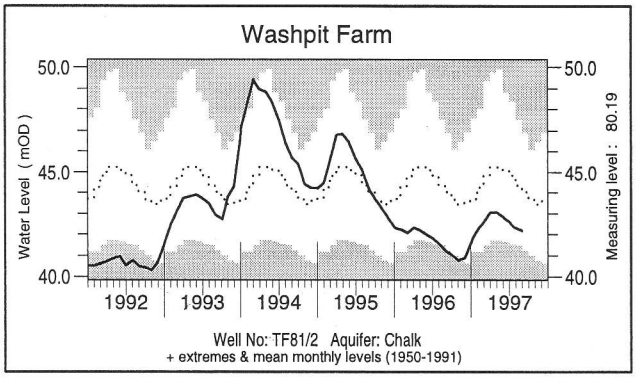
(a) River	%lta	Rank	River	%lta	Rank
Leven	197	35/37	Mimram	45	3/45
Witham	182	37/39	Kennet	54	2/36
Exe	190	39/42	Coln	59	2/34
Otter	177	34/35	Avon (Hants)	54	2/33
Kenwyn	145	27/29	Lune	28	2/37
Tone	557	37/37	Carron	50	2/19

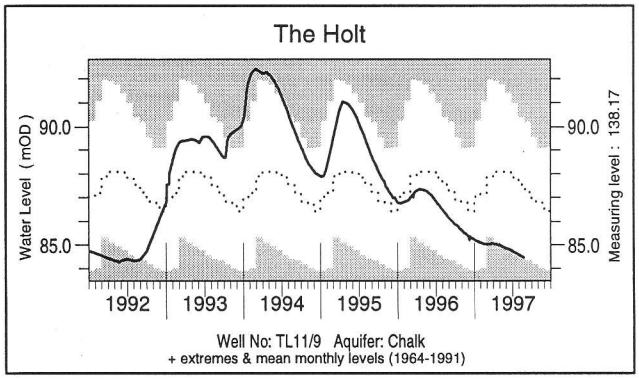
(b) River	%lta	Rank
Wharfe	72	1/30
Trent	59	1/37
Coln	65	1/32
Medway	51	1/30
Dee (Welsh)	69	1/58

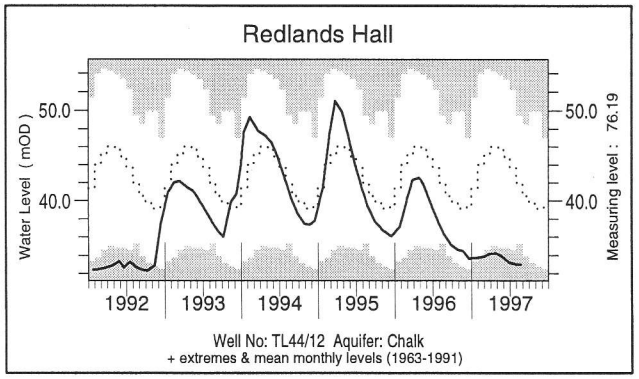
lta = long term average
Rank 1 = lowest on record

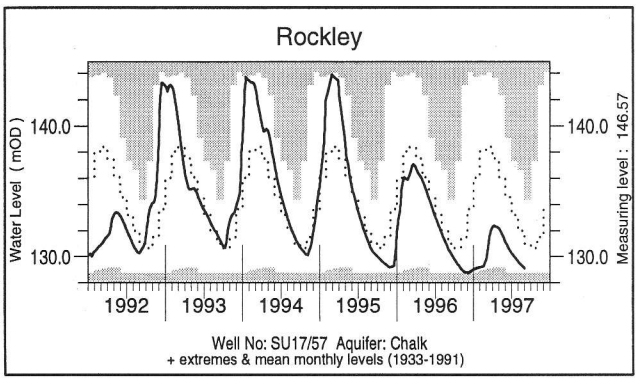
Groundwater . . . Groundwater

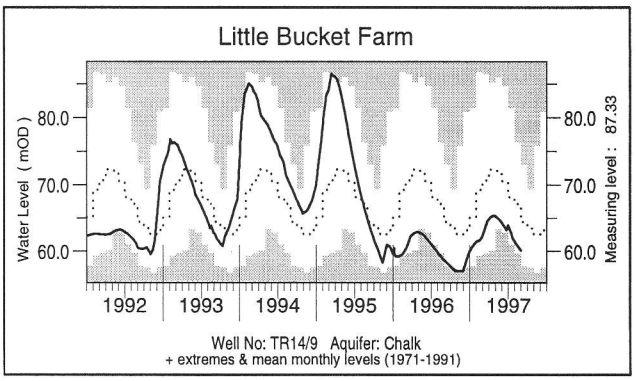


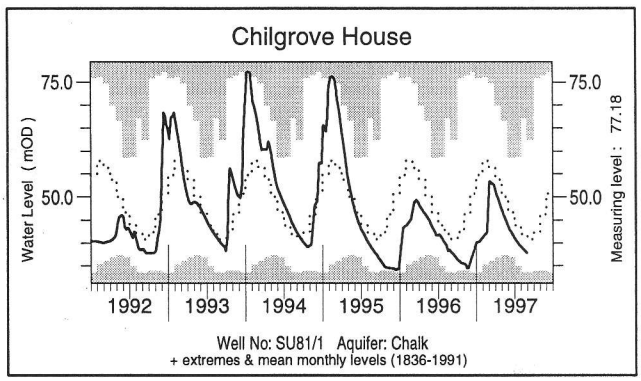


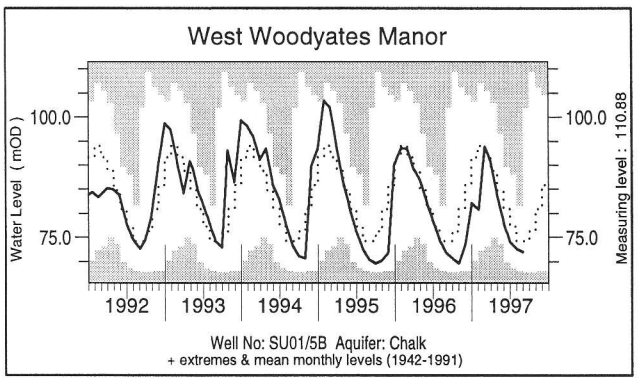








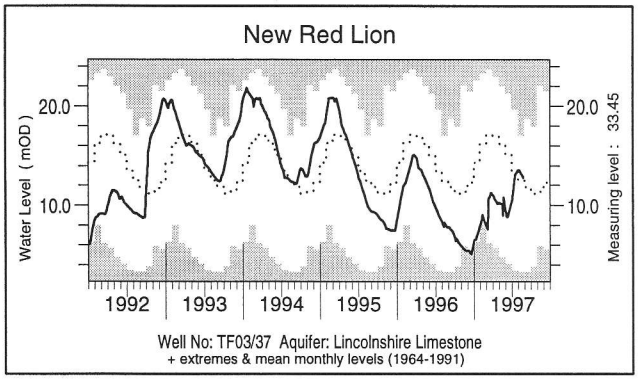


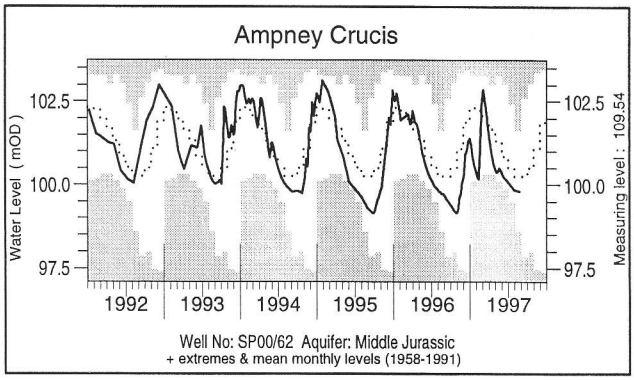


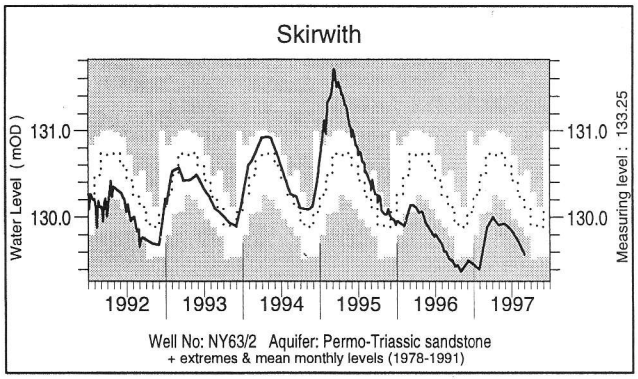
What is groundwater?

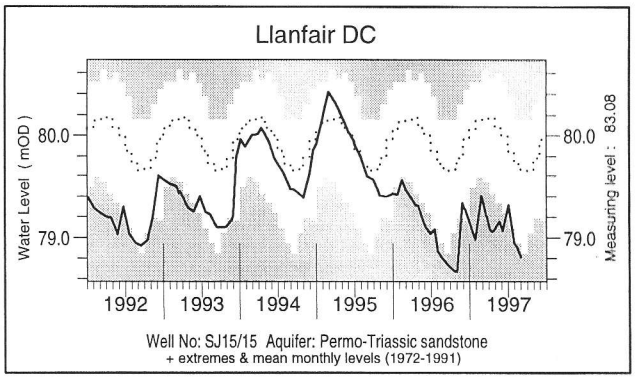
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment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

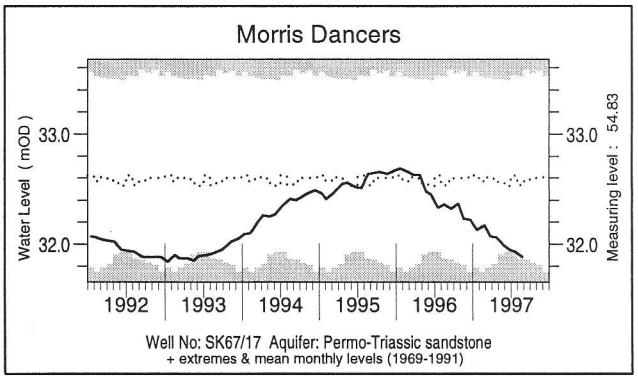
Groundwater . . . Groundwater

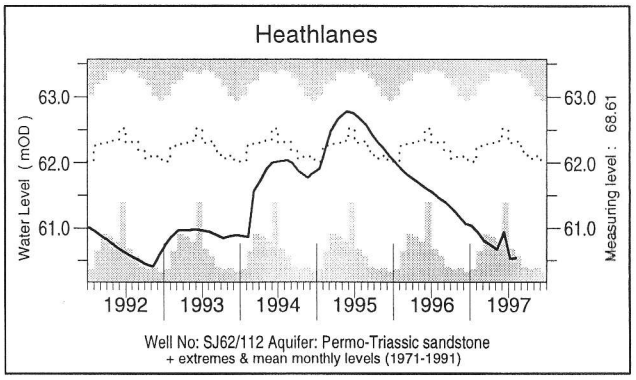


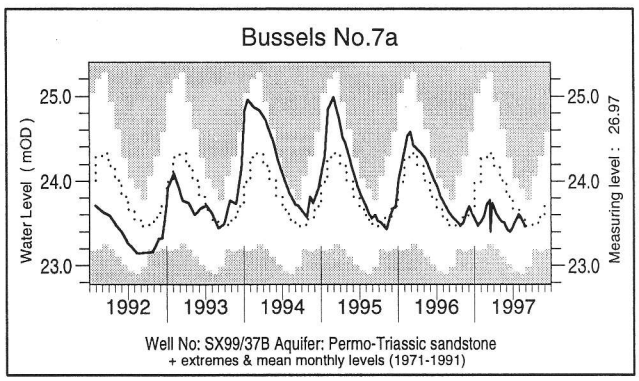


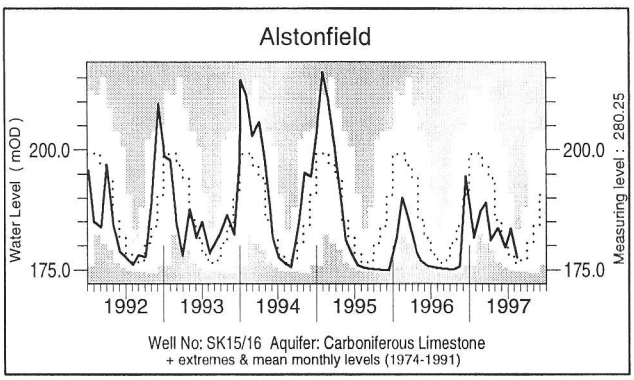












Groundwater levels August/September 1997

Borehole	Level	Date	Aug av.
Dalton Holme	14.2	1/9	16.25
Washpit Farm	42.2	1/9	44.33
The Holt	84.4	1/9	87.55
Redlands Hall	33.0	21/8	40.90
Rockley *	129.1	1/9	131.94
Little Bucket	60.1	1/9	66.69

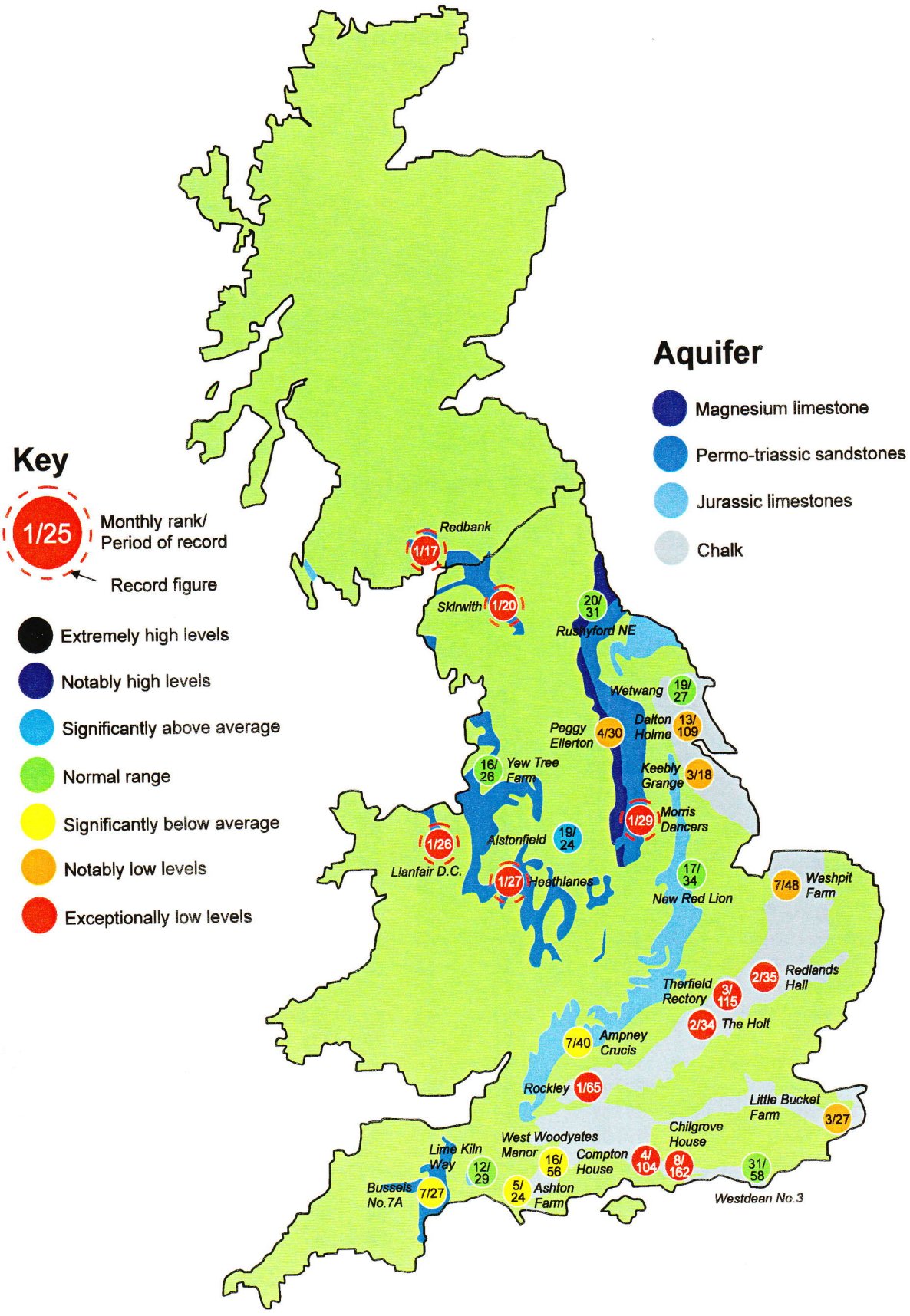
Borehole	Level	Date	Aug av.
Chilgrove	37.9	29/8	41.74
W Woodyates	71.9	1/9	73.90
New Red Lion	12.7	28/8	12.23
Ampney Crucis	99.8	26/8	100.18
Skirwith	129.6	1/9	130.15

Borehole	Level	Date	Aug av.
Llanfair DC	78.8	1/9	79.54
Morris Dancers	31.9	25/8	32.46
Heathlanes	60.5	6/8	62.09
Bussels	23.5	28/8	23.56
Alstonfield	177.5	14/8	176.84

**Data from new Rockley borehole*

Levels in metres above Ordnance Datum

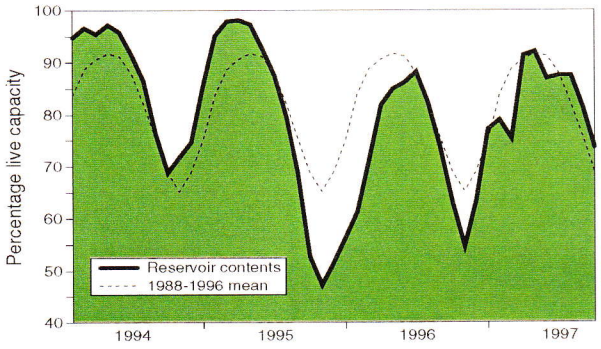
Groundwater . . . Groundwater



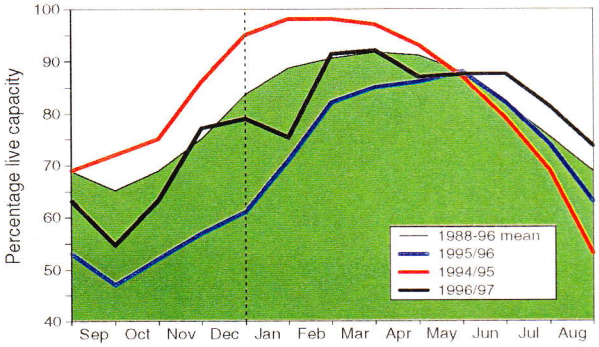
Groundwater levels - August 1997

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 Apr	May	Jun	Jul	Aug	**Sep**	Min. Sep	Year of min
North West	N Command Zone	• 133375	97	87	88	78	66	53	24	1995
	Vyrnwy	55146	95	86	87	90	75	65	36	1995
Northumbrian	Teesdale	• 87936	97	89	85	87	84	74	39	1991
	Kielder	(199175)	(93)	(90)	(92)	(94)	(94)	(85)	(66)	1989
Severn Trent	Clywedog	44922	97	98	98	98	91	80	38	1989
	Derwent Valley	• 39525	100	95	98	100	90	80	34	1995
Yorkshire	Washburn	• 22035	93	86	89	99	87	77	34	1995
	Bradford supply	• 41407	98	90	95	96	87	76	21	1995
Anglian	Grafham	58707	77	73	72	70	66	59	59	**1997**
	Rutland	130061	76	72	75	75	78	76	66	1995
Thames	London	• 206399	94	93	88	88	77	67	62	1995
	Farmoor	• 13843	98	98	98	100	98	99	64	1995
Southern	Bewl	28170	98	91	84	79	74	65	38	1990
	Ardingly	4685	100	100	98	92	93	86	47	1996
Wessex	Clatworthy	5364	99	89	79	97	91	91	31	1995
	Bristol WW	• (38666)	(95)	(92)	(88)	(85)	(74)	(72)	(43)	1990
South West	Colliford	28540	58	56	52	51	47	43	43	**1997**
	Roadford	34500	62	60	59	58	57	56	40	1995
	Wimbleball	21320	91	84	79	84	81	84	40	1995
	Stithians	5205	97	89	79	76	66	70	30	1990
Welsh	Celyn and Bren	• 131155	98	94	97	98	93	83	49	1989
	Brianne	62140	97	86	96	99	93	92	55	1995
	Big Five	• 69762	95	85	88	88	74	71	29	1995
	Elan Valley	• 99106	99	91	97	99	89	84	46	1995
East of Scotland	Edinburgh/Mid	• 97639	100	94	94	92	90	71	65	1989
	East Lothian	• 10206	99	98	100	100	94	80	63	1989
West of Scotland	Loch Katrine	• 111363	100	96	94	82	68	56	50	1995
	Daer	22412	98	94	94	87	74	60	41	1995
	Loch Thom	• 11840	100	94	95	77	69	58	58	**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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