Hydrological summary for Great Britain

July 1999

General

July was an exceptionally dry and very warm month throughout most of Great Britain. Evaporative demands were notably high and, by month end, soils were extremely dry in many areas. Reservoir contents declined briskly in July, overall stocks falling from 92% to 83% of capacity – but remain considerably above average for the late summer. Water supply difficulties were experienced in a few localities (e.g. in Kent) as heatwave conditions triggered a surge in demand which stressed the water supply network. Generally runoff rates and groundwater levels are within the normal range for the late summer. However, depressed late-July river flows were reported from some impermeable catchments in southern England – triggering restrictions on spray irrigation in a few catchments. In such areas the heavy early August rainfall was especially welcome.

Rainfall

The unsettled conditions of the early summer continued into July and, as temperatures and humidity levels increased, thunderstorms were triggered in many localities. Light winds resulted in sluggish storm cell movement and some rainfall totals were very notable e.g. 34 mm in a hour near Bolton and 58 mm in under three hours at Andover on the 5th and, on the 10th, a 2.5 hour storm total of 82 mm (including a remarkable 49 mm in an hour) was reported from Corsock in south-west Scotland. Sporadic thunderstorms continued but anticyclonic conditions predominated from the end of the first week. Much of southern Britain reported more than 25 dry days in July and, in those areas which missed the thunderstorms, rainfall totals were remarkably low (e.g. 2 mm for the Thames headwaters, 1.5 mm at Havant - the lowest for any month since February 1934). The very large spatial variability in the rainfall dictates caution in interpreting the provisional regional rainfall totals – they are calculated from a small subset of raingauges. Initial estimates indicate that parts of western Scotland recorded well above average rainfall but the majority of southern Britain recorded considerably below 50%, monthly totals of <10 mm being common. England and Wales registered its driest month since January 1997 and the provisional rainfall total for July is the second lowest this century (after 1911), it ranks amongst the driest half dozen in a series from 1766. Notwithstanding the very limited July rainfall, accumulated totals in the 3- and 6-month timeframes are in the normal range for most regions albeit significantly below average in the south (e.g. parts of Essex and Hampshire where, for Havant, the February-July total is lowest since 1976). In the 12-month timeframe regional rainfall totals are above average throughout Britain.

River Flows

Media coverage focussed on a number of severe but short-lived and very localised urban flood events (e.g. Nottingham on the 3rd, Andover and Farnham on the 5th). Such events were relatively common – and are reflected in the July runoff totals for a few index rivers (e.g. the Essex Colne) but they coexisted with notable recessions in most main rivers. These produced depressed flow rates especially in southern rivers with little or no baseflow support. Only in 1976 has a significantly lower July runoff been recorded on the River Wallington (Hants). Flows in the Kent Stour were healthier but the Horton gauging station still registered an eighth successive year with July runoff below the preceding mean. Most rivers in England and Wales reported July runoff totals moderately below average and, in the south, 6-month accumulations are low in many impermeable catchments. By contrast, flows (and accumulated runoff totals) are above average throughout much of Scotland, notably so for the Clyde where two significant summer spates contributed to a new July runoff maximum in an 37-year record.

Groundwater

High temperatures and lengthy periods of sunshine transformed relatively moist early summer soils into very parched conditions throughout much of southern Britain by late July. As usual in mid-summer, infiltration and recharge was minimal (thunderstorms producing a few very localised exceptions). Apart from the slowest responding aquifer units, groundwater level recessions continued. Levels for index wells in the Chalk were well within the normal July range indicating that overall storage is very close to the late summer average. Levels in the limestone aquifers are, similarly, typical of mid-summer although well above average in the Magnesian Limestone. Differing response times, recharge patterns and, in some areas, abstraction regimes, make for much less spatial continuity in the Permo-Triassic sandstones. However, levels in most wells and boreholes – including Weeford Flats which was dry entering 1999 - are also within the normal range. A continuing exception is Morris Dancers (in the Sherwood Sandstone

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall . .

Rainfall accumulations and return period estimates

Area	Rainfall	Jul 1999	May 99-Jul 99	RP	Feb 99-Jul 99	RP	Aug 98-Jul 99	RP	Aug 97-Jul 99	RP
England & Wales	**mm**	**21**	**154**		**336**		**900**		**1905**	
	%	**34**	**80**	**2-5**	**87**	**2-5**	**100**	**<2**	**106**	**2-5**
North West	mm	33	223		470		1273		2503	
	%	39	92	2-5	97	2-5	106	2-5	104	2-5
Northumbrian	mm	27	198		391		932		1911	
	%	42	106	2-5	105	2-5	109	2-5	112	5-10
Severn Trent	mm	17	149		334		853		1680	
	%	32	87	2-5	98	2-5	113	5-10	111	5-10
Yorkshire	mm	20	169		385		862		1765	
	%	34	94	2-5	106	2-5	105	2-5	107	2-5
Anglian	mm	25	137		269		662		1324	
	%	51	93	2-5	97	2-5	111	2-5	111	5-10
Thames	mm	16	143		265		743		1503	
	%	33	89	2-5	85	2-5	108	2-5	109	2-5
Southern	mm	15	114		251		779		1689	
	%	31	73	5-10	77	5-10	100	<2	108	2-5
Wessex	mm	13	135		313		885		1940	
	%	25	79	2-5	87	2-5	106	2-5	116	10-20
South West	mm	15	162		435		1212		2656	
	%	22	77	2-5	91	2-5	103	2-5	113	5-10
Welsh	mm	26	191		495		1431		2929	
	%	34	80	2-5	95	2-5	109	2-5	112	5-10
Scotland	**mm**	**86**	**306**		**670**		**1682**		**3190**	
	%	**92**	**115**	**2-5**	**118**	**5-10**	**117**	**10-20**	**111**	**10-20**
Highland	mm	98	350		861		2030		3813	
	%	92	118	2-5	127	20-30	115	5-15	108	5-10
North East	mm	54	213		435		1020		2103	
	%	74	102	2-5	106	2-5	105	2-5	108	5-10
Tay	mm	69	272		538		1469		2799	
	%	90	117	2-5	108	2-5	120	10-20	114	10-20
Forth	mm	72	279		508		1405		2592	
	%	97	128	5-10	113	2-5	127	35-50	117	30-40
Tweed	mm	46	231		417		1081		2116	
	%	63	110	2-5	101	2-5	111	5-10	109	5-10
Solway	mm	96	330		656		1756		3303	
	%	107	127	5-10	118	5-10	124	25-40	116	20-30
Clyde	mm	116	349		757		1974		3680	
	%	106	119	2-5	118	5-10	116	5-15	108	5-10

RP = Return period

 All monthly totals since July 1998 are provisional (see page 12). 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. *See page 12.

Rainfall . . . Rainfall . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

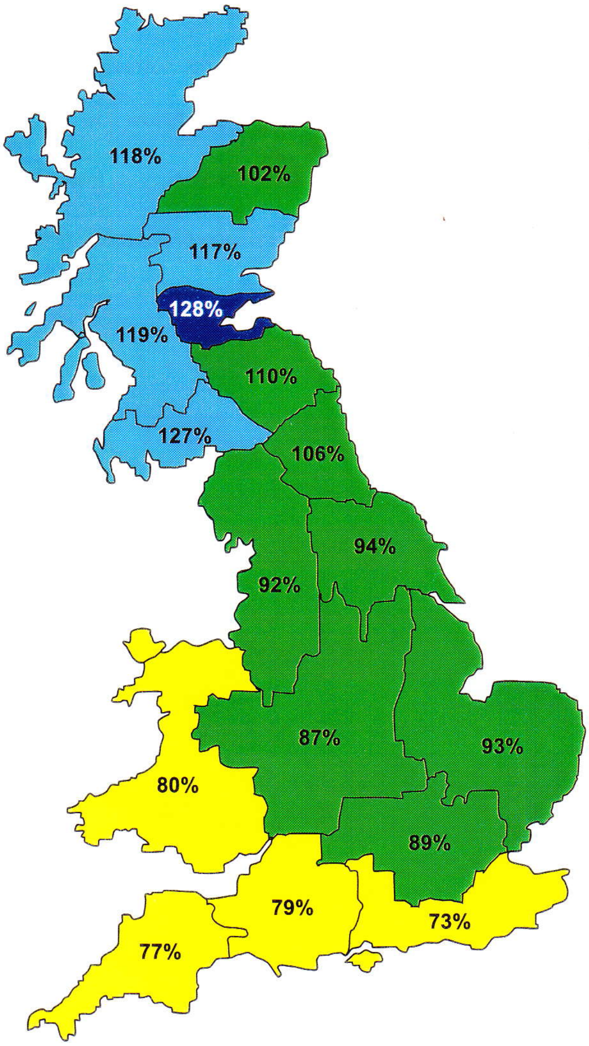
Above average

Normal range

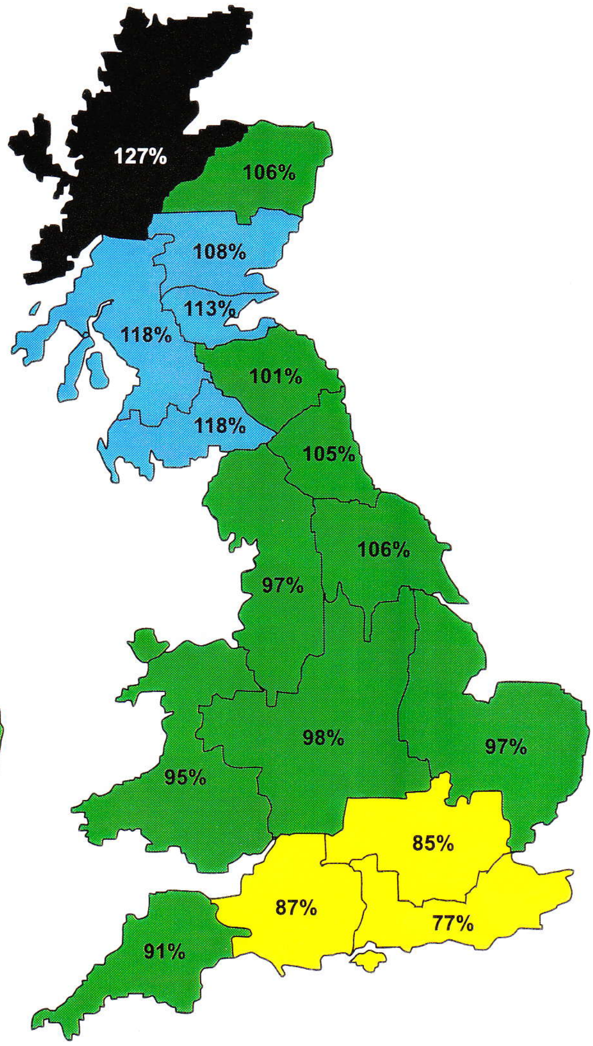
Below average

Substantially below average

Exceptionally low rainfall



May 1999 - July 1999

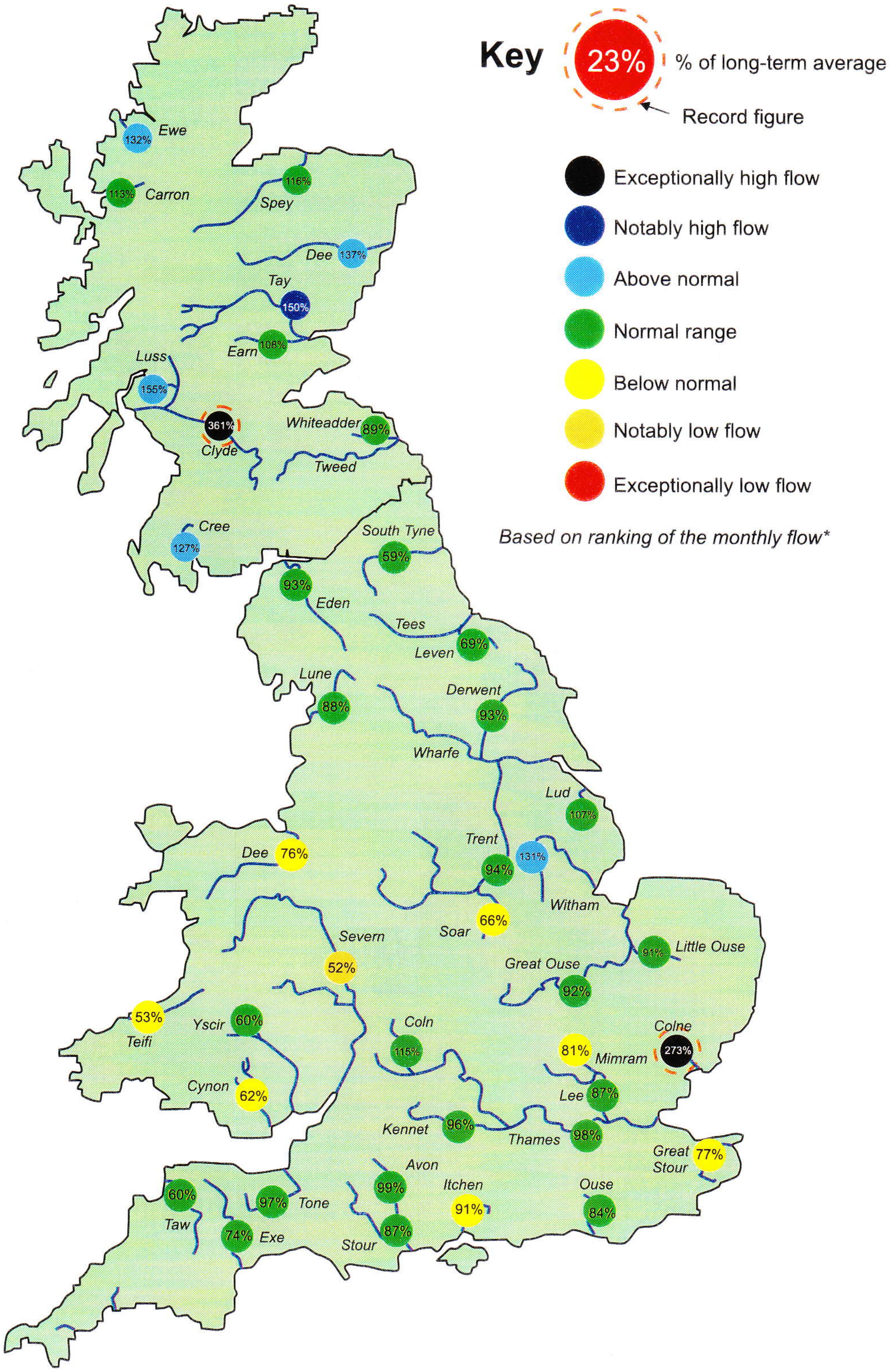


February 1999 - July 1999

Rainfall accumulation maps

Rainfall for Great Britain over the three- and six-month periods ending in July is only a little below average but regional contrasts are substantial. Scotland (provisionally) reported its ninth wettest February-July period in a series from 1869 (but four of the higher totals cluster in the last ten years) whereas Southern Region (again provisionally) registered its second lowest February-July rainfall since 1962, 1976 was much drier.

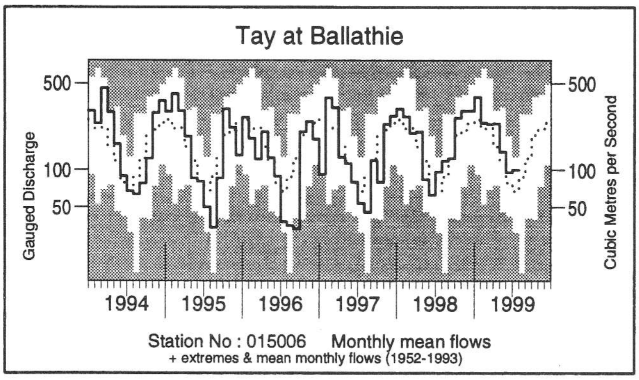
River flow . . . River flow . . .

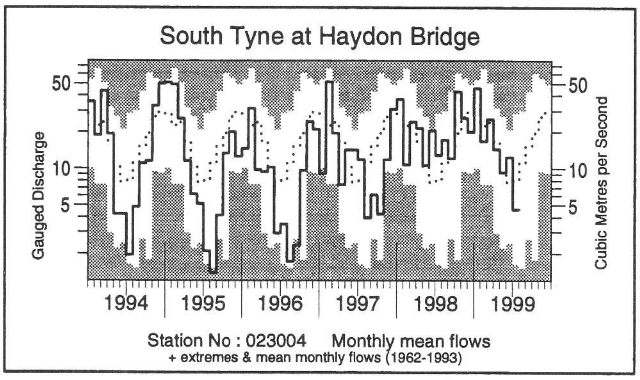


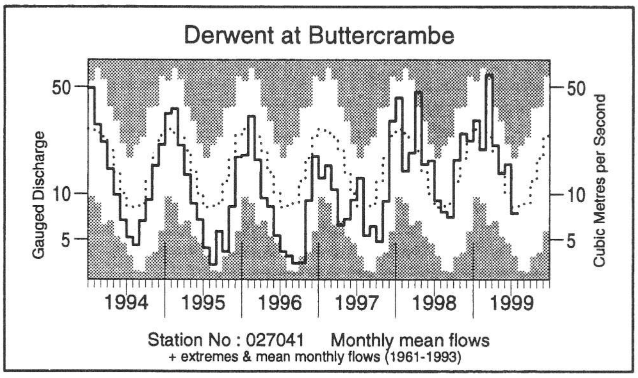
River flows - July 1999

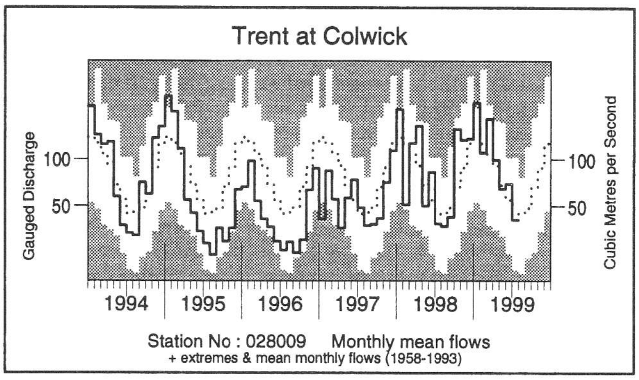
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

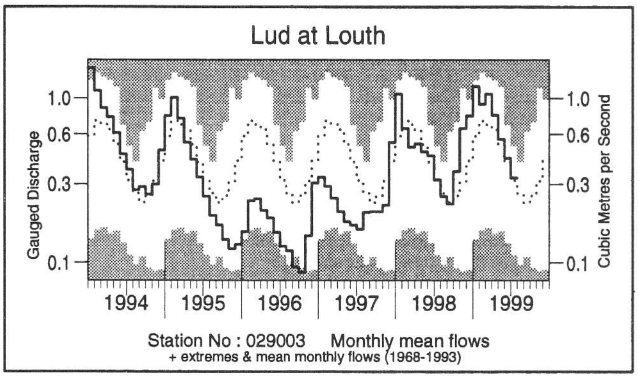
River flow . . . River flow . .

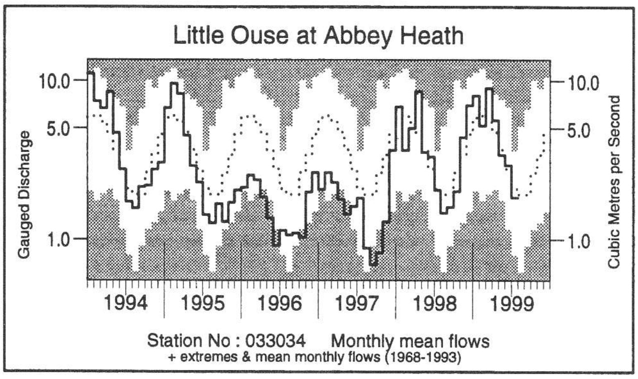


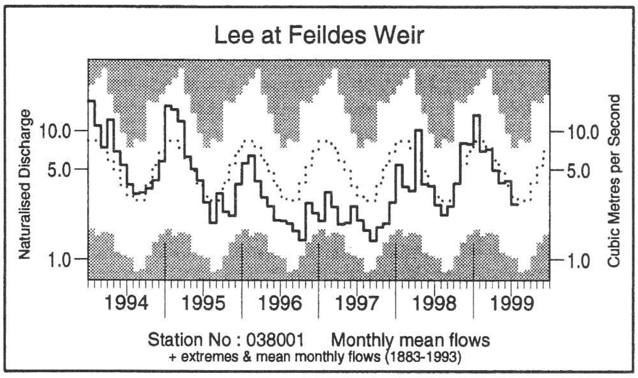


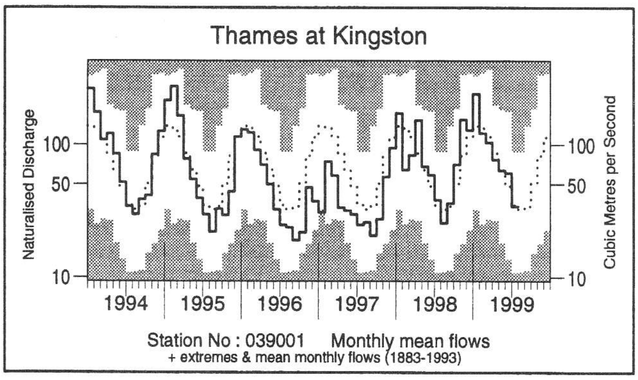








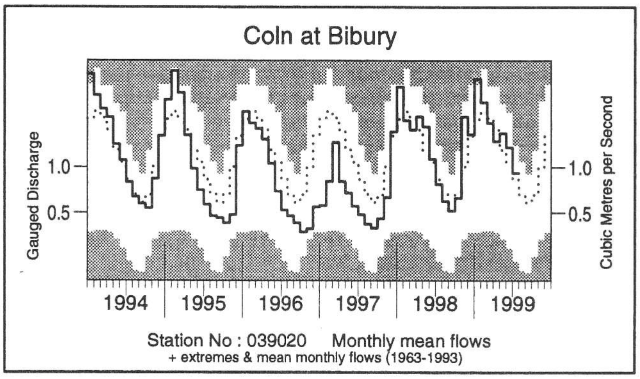


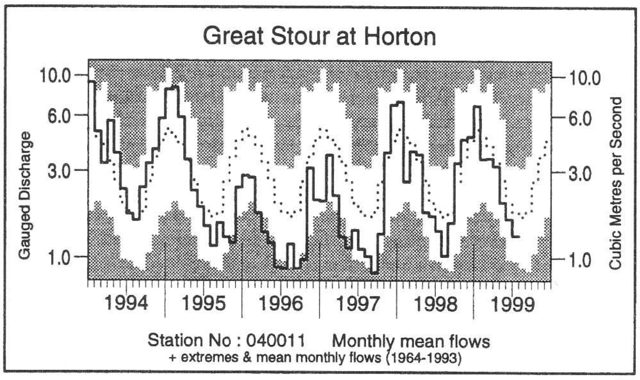


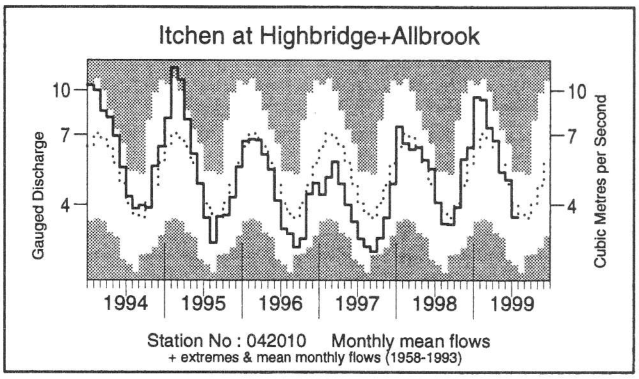
Monthly river flow hydrographs

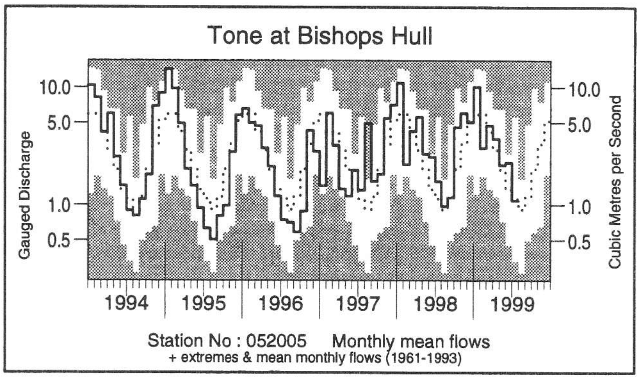
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1994 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

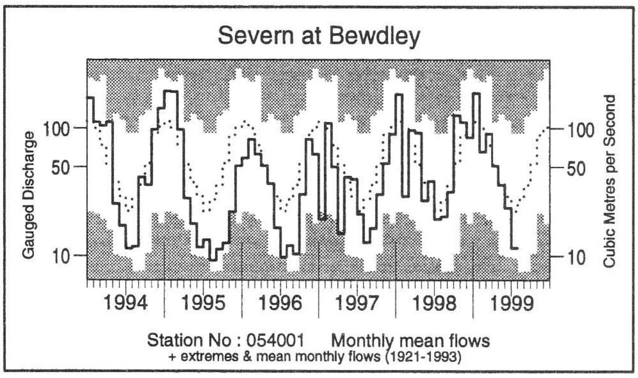
River flow . . . River flow . . .

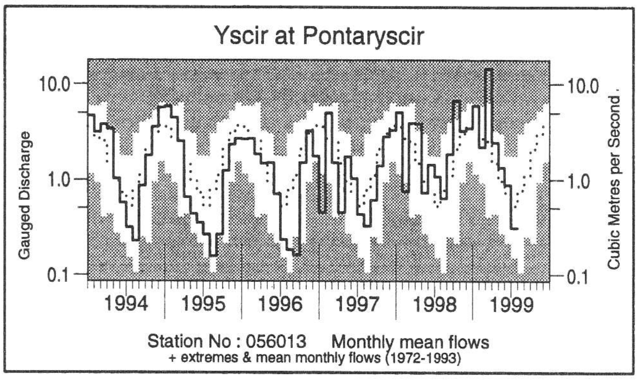


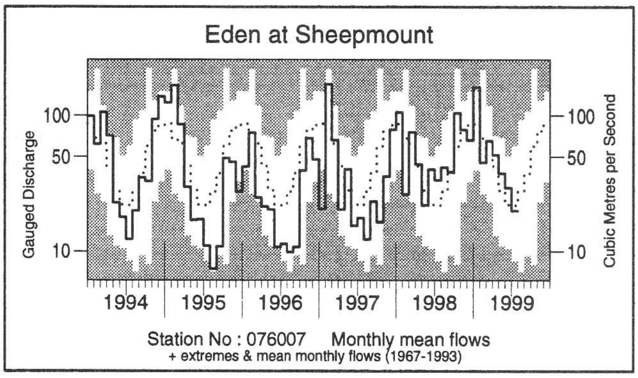


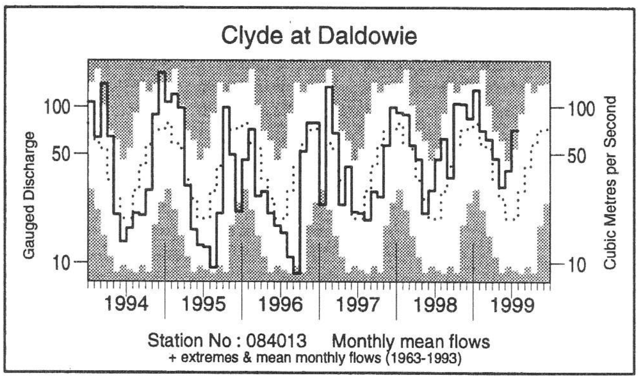










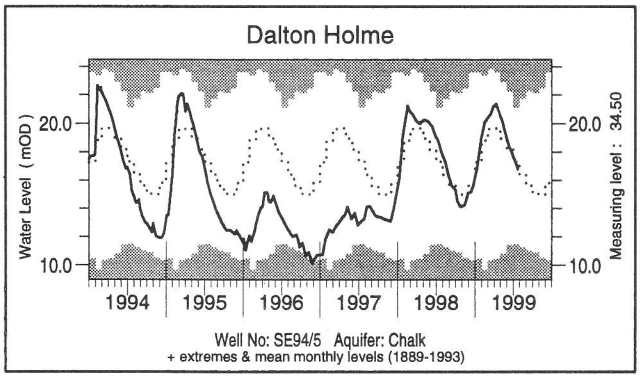


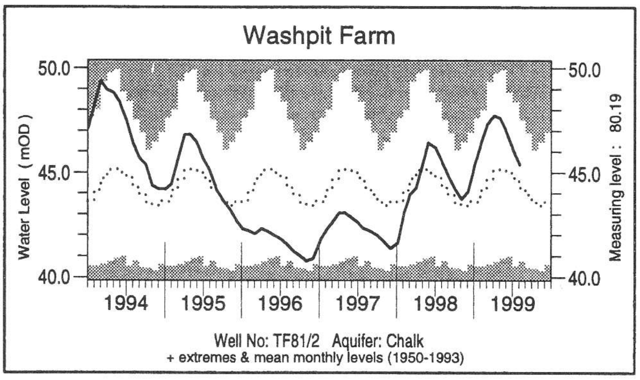
Notable runoff accumulations August 1998 - July 1999 (a); August 1997 - July 1999 (b)

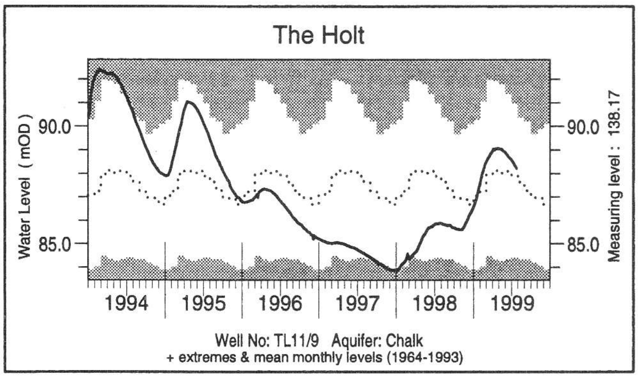
(a) River	%lta	Rank	River	%lta	Rank	(b) River	%lta	Rank
Earn	130	48/51	Cynon	125	36/39	Witham	155	39/39
Tweed	122	36/38	Teifi	122	38/40	Exe	127	40/42
Trent	131	38/40	Lune	124	35/37	Yscir	146	25/25
Witham	163	36/40	Clyde	145	35/			

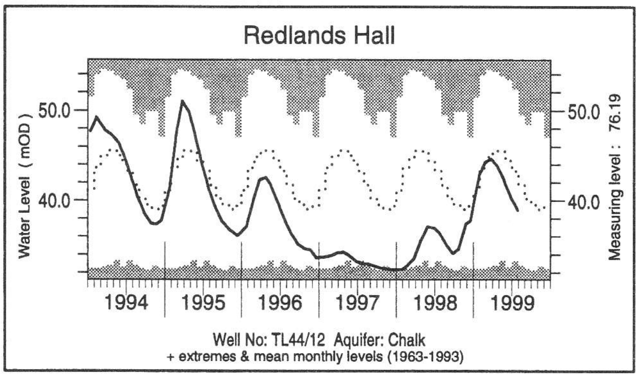
lta = long term average
Rank 1 = lowest on record

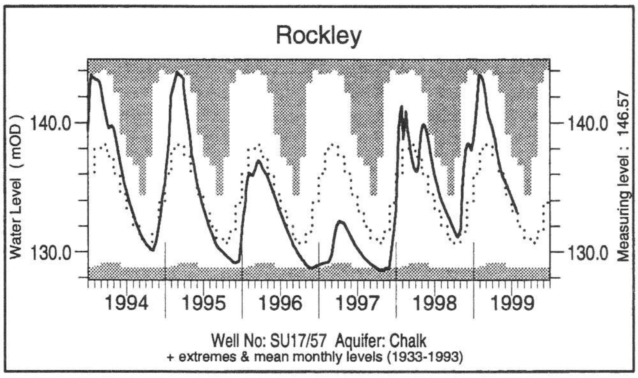
Groundwater . . . Groundwater

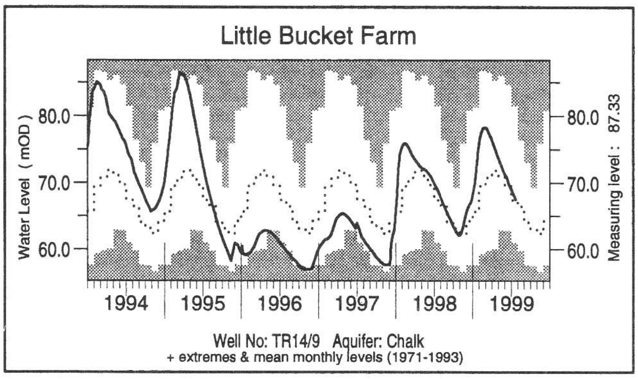


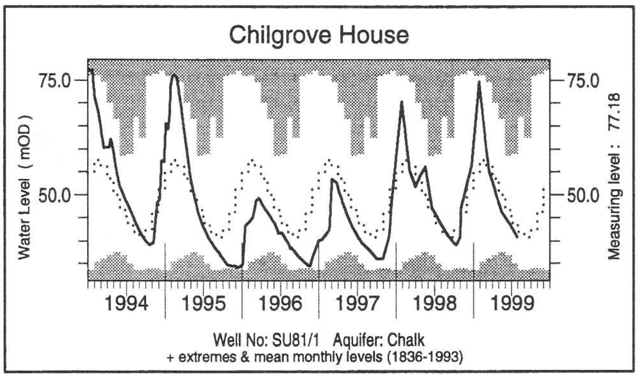


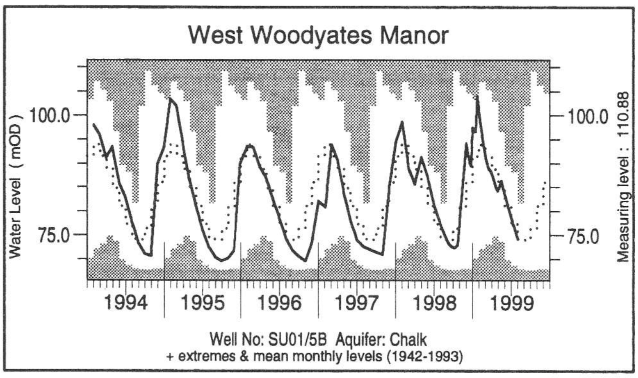








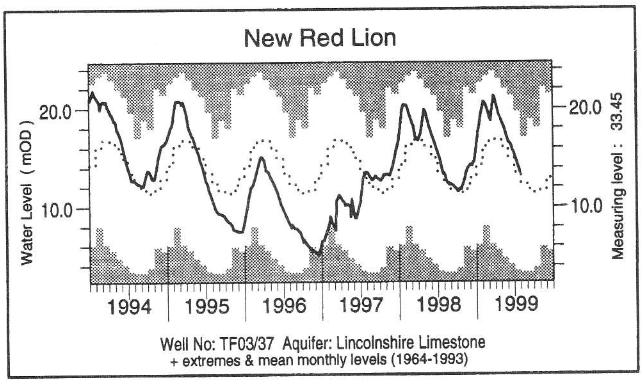




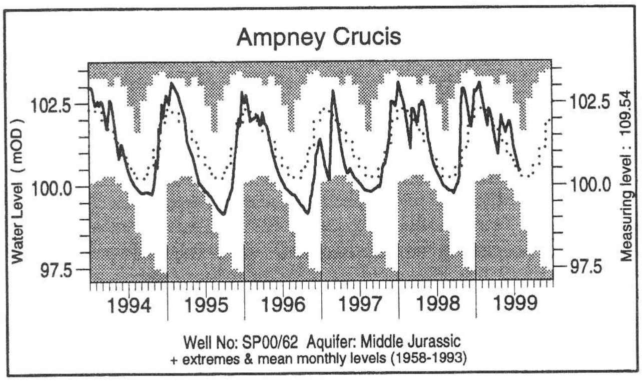
What is groundwater?

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.

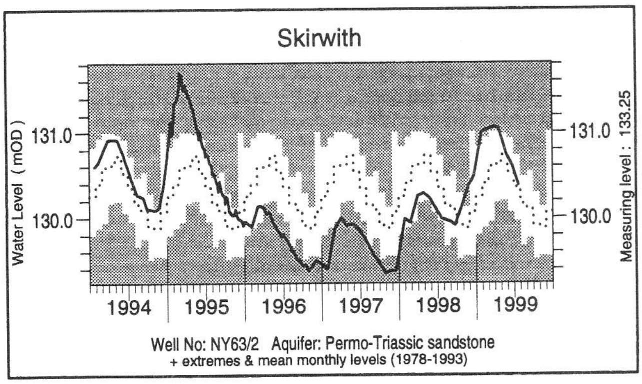
Groundwater . . . Groundwater



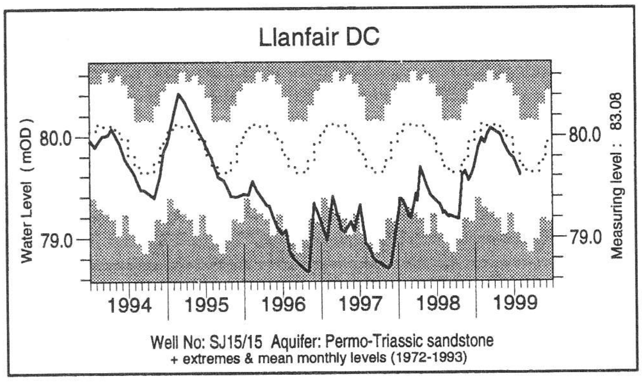
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1993)



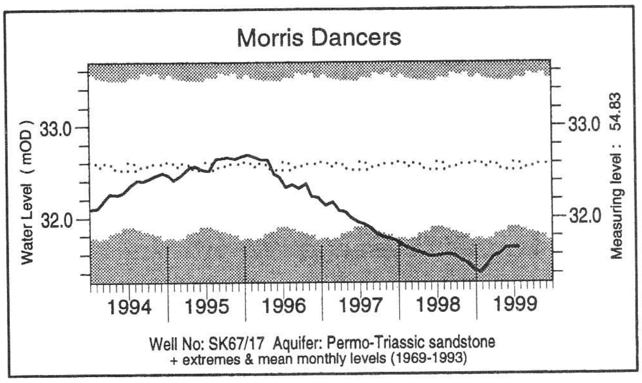
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1993)



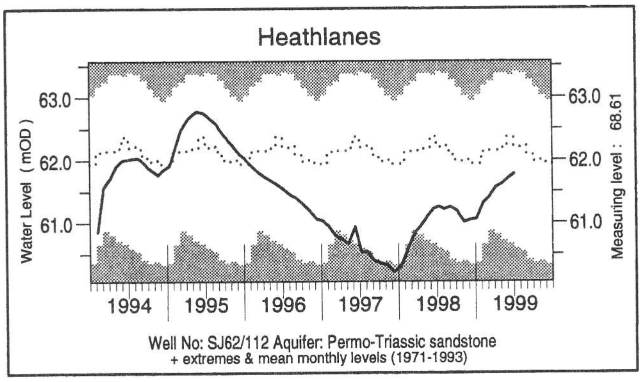
Well No: NY63/2 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1978-1993)



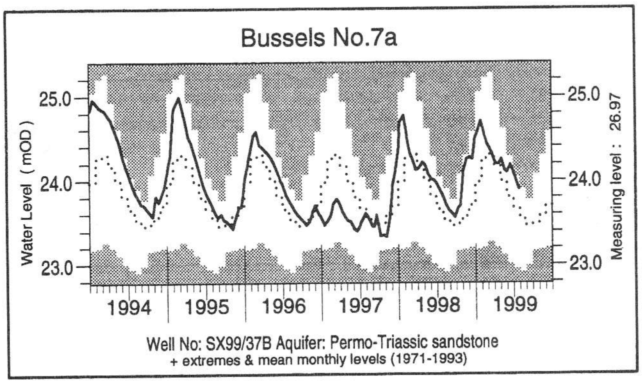
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1993)



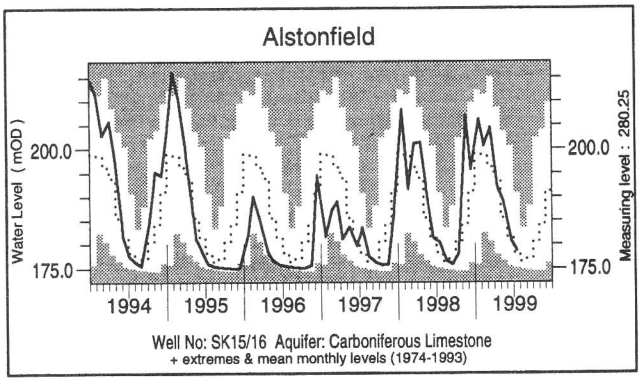
Well No: SK67/17 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1969-1993)



Well No: SJ62/112 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1993)



Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1993)



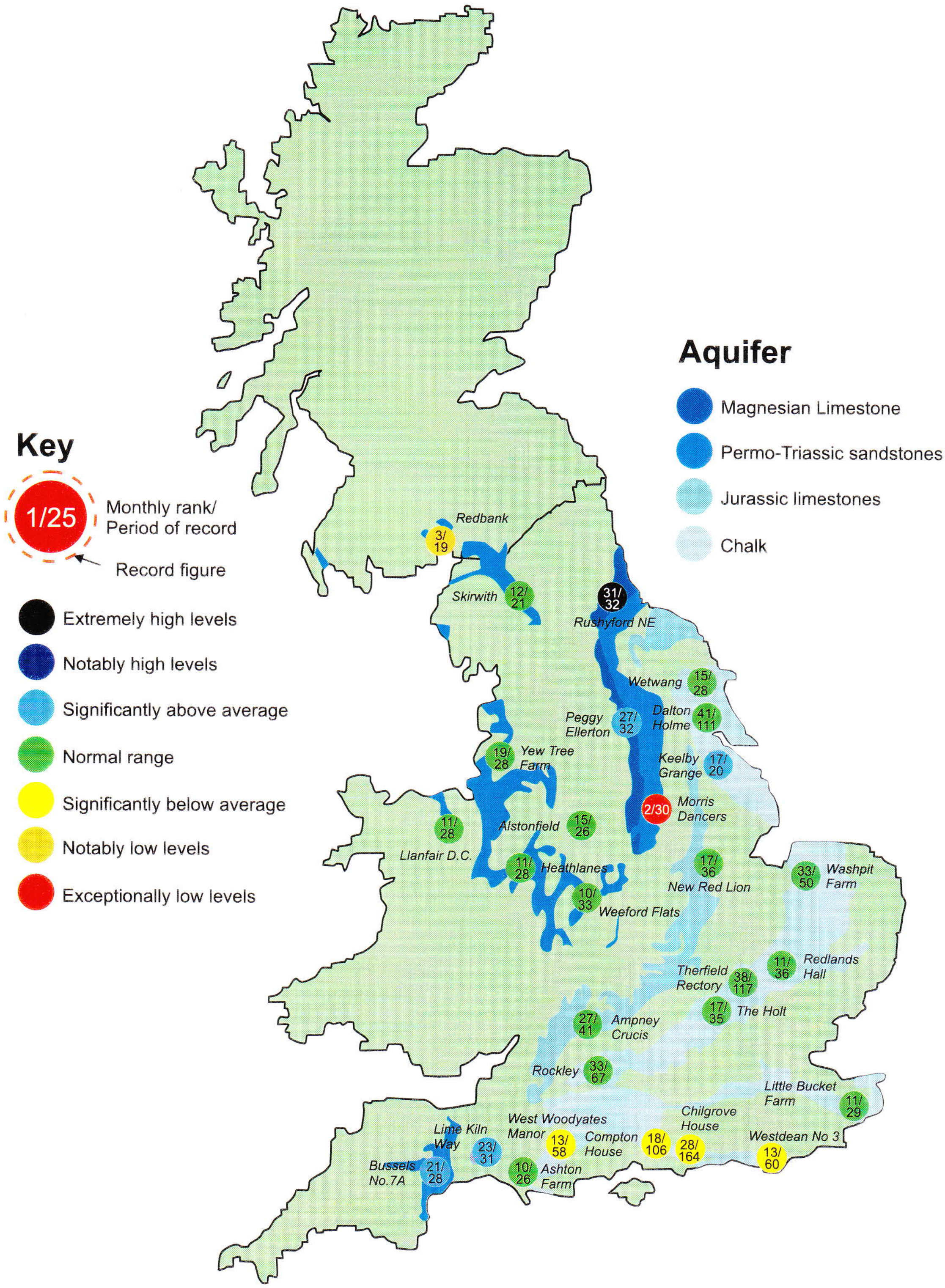
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1993)

Groundwater levels July/August 1999

Borehole	Level	Date	Jul av.
Dalton Holme	16.77	23/07	17.17
Washpit Farm	45.37	03/08	44.70
The Holt	88.20	26/07	88.02
Redlands Hall	38.93	27/07	42.41
Ashton Farm	66.17	31/07	66.65
Little Bucket	67.53	21/07	68.19
Chilgrove	40.82	28/07	43.56
W Woodyates	74.28	31/07	76.87
New Red Lion	13.44	28/07	13.26
Ampney Crucis	100.40	26/07	100.47
Skirwith	130.38	22/07	130.27
Llanfair DC	79.61	01/08	79.67
Morris Dancers	31.67	21/07	32.45
Heathlanes	61.78	03/07	62.12
Bussels	23.89	27/07	23.69
Alstonfield	178.68	15/07	178.81

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

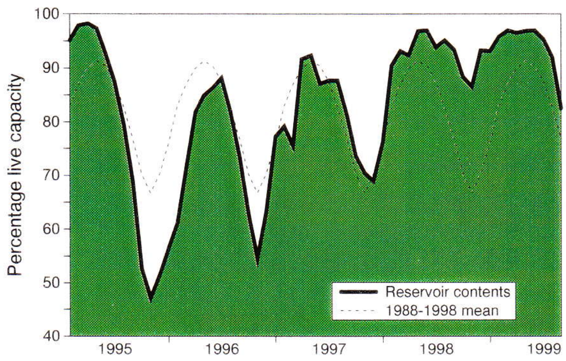


Groundwater levels - July 1999

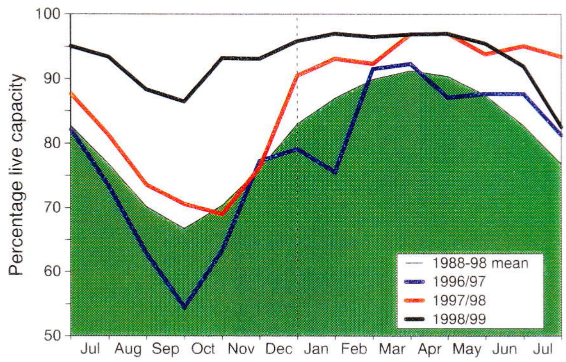
The rankings are based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods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

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 Mar	Apr	May	Jun	Jul	**Aug**	Min. Aug	Year* of min
North West	N Command Zone	• 133375	93	93	96	94	81	71	38	1989
	Vyrnwy	55146	100	97	98	96	87	82	56	1996
Northumbrian	Teesdale	• 87936	97	98	95	94	86	69	45	1989
	Kielder	(199175)	(95)	(95)	(95)	(95)	(93)	(89)	(66)	1989
Severn Trent	Clywedog	44922	93	94	99	99	98	82	57	1989
	Derwent Valley	• 39525	100	100	100	95	90	79	43	1996
Yorkshire	Washburn	• 22035	98	96	98	96	92	83	50	1995
	Bradford supply	• 41407	96	96	98	94	90	77	38	1995
Anglian	Grafham	** (55490)	(93)	(98)	(98)	(96)	(93)	(88)	(66)	1997
	Rutland	**(116580)	(95)	(97)	(96)	(92)	(88)	(83)	(74)	1995
Thames	London	• 206399	94	98	95	93	95	89	73	1990
	Farmoor	• 13843	98	98	95	96	99	97	84	1990
Southern	Bewl	28170	100	99	98	92	84	74	45	1990
	Ardingly	4685	100	100	100	99	92	81	66	1995
Wessex	Clatworthy	5364	97	97	99	98	95	75	43	1992
	Bristol WW	• (38666)	(98)	(98)	(97)	(91)	(88)	(76)	(53)	1990
South West	Colliford	28540	100	100	100	100	99	92	47	1997
	Roadford	34500	94	95	96	93	93	90	46	1996
	Wimbleball	21320	100	99	100	100	99	88	53	1992
	Stithians	5205	99	99	99	98	96	86	39	1990
Welsh	Celyn and Brenig	• 131155	100	100	100	100	100	83	65	1989
	Brianne	62140	99	97	99	100	100	91	67	1995
	Big Five	• 69762	99	95	97	96	92	74	41	1989
	Elan Valley	• 99106	100	97	99	98	92	81	63	1989
East of Scotland	Edinburgh/Mid Lothian	• 97639	73	76	81	82	82	80	51	1998
	East Lothian	• 10206	99	99	99	97	98	94	72	1992
West of Scotland	Loch Katrine	• 111363	93	95	93	95	94	89	68	1997
	Daer	22412	100	100	97	100	91	87	58	1994
	Loch Thom	• 11840	100	100	97	93	89	90	69	1997

() 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 area; this can be particularly important during droughts.
The minimum storage figures relate to the 1988-1999 period only. 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

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. The national rainfall figures for June, and the regional totals for England and Wales were derived by the UK Climate Studies Group at the Met. Office. In England and Wales other 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 discontinuation of the CARP system used by the Met. Office to provide more definitive regional rainfall assessments means that the recent 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.

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