

Hydrological summary *for Great Britain*

General

September was a very mild month with rainfall favouring the normally drier regions of the country. Reservoir contents increased in parts of Wales but declined modestly in some eastern areas. Nonetheless, overall stocks for England and Wales were the highest in early October for ten years. September mean flows in most rivers were close to the seasonal average and the wetting-up of lowland soils provides encouragement that the onset of the 1998/99 recharge season in the east will not be long delayed - this will be particularly important in those relatively few areas where groundwater levels remain depressed.

Rainfall

The month began in an unsettled vein - Birmingham had exceeded its average September rainfall by the 9th - and an active frontal system produced widespread and heavy rainfall on the 10th. From around the 18th 'Indian Summer' conditions became established across much of the country, many areas registered 12 or more days in succession with no more than a trace of rain. Very unsettled conditions returned towards month-end. The passage of a very humid air mass on the 26th produced >25 mm of rainfall over much of the English lowlands - at Aylesbury (Bucks), a remarkable 106 mm was recorded in 13.5 hours (the associated return period exceeds 500 years). For the month as whole, anticyclonic conditions were dominant in Scotland whilst most rain-bearing frontal systems tracked across southern Britain. This unusual synoptic pattern resulted in a reversal of the normal rainfall gradient: parts of western Scotland reported only around a third of average whereas some lowland districts of England registered more than twice the average. Rainfall over the last three months is generally a little below average, appreciably so in parts of northern England. Accumulated totals were much healthier over the summer half-year (Apr-Sept). Despite a relatively dry July and August, only 1992 has been significantly wetter in parts of the English lowlands over the last 30 years; the Apr-Sept period was also wet in parts of eastern Scotland - notably so in the Forth region. Regional rainfall totals for the year thus far, and over the last 12 months, are above average in all regions.

River Flows

Except in some spring-fed rivers the summer flow recessions were reversed in September with runoff rates increasing particularly sharply near month-end in the south. Storms on the 26th triggered flood warnings in a few catchments (e.g. the headwaters of the Thames and upper Lee where some flooding was reported at Harpenden). Elsewhere, spates were of modest magnitude and exceptional runoff rates were mostly localised and short-lived. Most September runoff totals were well within the normal range although rainfall patterns - and geological contrasts between catchments - made for significant spatial variability. Notably high September flows were registered in some relatively low-lying catch-

ments in eastern Scotland whilst, to the west and north, flows were very modest - the Carron recording its third lowest September runoff totals on record. Low runoff rates also characterised some baseflow dominated rivers in eastern England, but September mean flows were well above drought minima in all index catchments. The absence of sustained recessions through the summer produced very healthy Apr-Sept runoff totals - period of record maxima were approached on the Tweed, Yorkshire Derwent and Exe - those on the Bedford Ouse, Mole and Yscir were unprecedented. Flows for the last twelve months are generally above average in impermeable catchments but significantly below in many eastern catchments reliant on groundwater.

Groundwater

Soil moisture deficits declined unevenly through September but by month-end significant infiltration has begun in many western and northern outcrop areas. However, very dry soil conditions remained in parts of the English lowlands - Lincolnshire and Cambridgeshire especially. After erratic behaviour earlier in the year, groundwater levels in most index boreholes declined gently during September - following typical early autumn recessions. In the Chalk levels towards the western and northern extremities of the outcrop are very close to the seasonal average. A broad zone of depressed levels stretches from the London area to Cambridgeshire - at Redlands Hall levels have been well below average for three years and notably depressed since late-1996; a similar picture emerges for Therfield - where the lengthy record of levels testifies to the rarity of the conditions experienced in the 1990s, certainly in the context of the last 70 years. Although generally more responsive than the Chalk, levels have yet to rise significantly in the limestone aquifers where September levels were well within normal range. This applies also to many Permo-Triassic sandstones outcrop areas but depressed levels in some slow responding units - e.g. Morris Dancers which has remained below previous minima throughout 1998.

September 1998



**Institute of
Hydrology**



**British
Geological
Survey**

Rainfall . . . Rainfall . . . Rainfall .

Rainfall accumulations and return period estimates





Area	Rainfall	Sep 1998	Jul 98- Sep 98 RP	Apr 98-Sep 98 RP	Oct 97- Sep 98 RP	Oct 96- Sep 98 RP
England & Wales	mm %	87 113	193 90 2-5	475 118 5-10	1007 112 5-10	1851 103 2-5
North West	mm %	95 83	287 93 2-5	580 109 2-5	1257 104 2-5	2393 99 2-5
Northumbrian	mm %	70 95	250 114 2-5	591 149 70-100	1051 123 15-25	1904 112 5-10
Severn Trent	mm %	82 128	165 90 2-5	417 117 2-5	842 112 2-5	1578 105 2-5
Yorkshire	mm %	62 92	165 82 2-5	452 119 5-10	907 111 2-5	1711 104 2-5
Anglian	mm %	71 144	136 89 2-5	372 125 5-10	689 116 5-10	1256 105 2-5
Thames	mm %	103 174	159 96 2-5	406 124 5-10	779 113 2-5	1365 99 2-5
Southern	mm %	105 152	157 90 2-5	376 112 2-5	913 117 5-10	1584 102 2-5
Wessex	mm %	102 141	183 96 2-5	467 129 5-15	1013 121 5-15	1830 109 2-5
South West	mm %	118 126	249 101 2-5	590 129 10-15	1382 118 5-10	2503 107 2-5
Welsh	mm %	137 119	300 102 2-5	657 123 5-10	1504 115 5-10	2739 104 2-5
Scotland	mm %	94 66	362 103 2-5	655 109 2-5	1544 107 2-5	3083 107 5-10
Highland	mm %	85 50	369 91 2-5	674 98 2-5	1786 101 2-5	3706 105 2-5
North East	mm %	97 112	296 120 5-10	596 135 30-50	1139 117 10-15	2196 113 10-20
Tay	mm %	114 100	350 123 5-10	627 125 5-15	1392 113 5-10	2665 108 5-10
Forth	mm %	113 103	354 127 5-10	636 132 25-40	1295 117 5-15	2499 113 10-15
Tweed	mm %	75 84	236 94 2-5	566 128 10-20	1092 113 5-10	2194 113 10-15
Solway	mm %	110 77	421 120 2-5	723 121 5-10	1590 112 5-10	3053 107 2-5
Clyde	mm %	84 47	428 101 2-5	693 100 <2	1750 103 2-5	3455 102 2-5

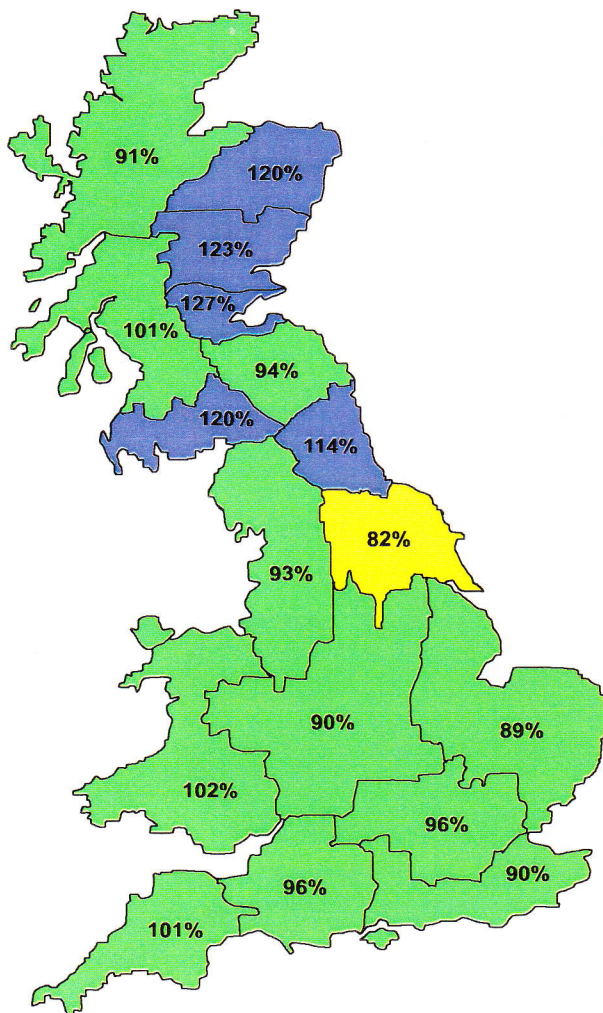
RP = Return period

The monthly rainfall figures* are copyright of the Met. Office and may not be passed on to any unauthorised person or organisation. Recent monthly rainfall figures for the Scottish regions have been compiled using data provided by the Scottish Environment Protection Agency. The return period estimates are based on tables provided by the Meteorological Office (see Tabony, R.C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37) and relate to the specified span of months only, (return periods may be up to an order of magnitude less if n-month periods beginning in any month are considered). 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.

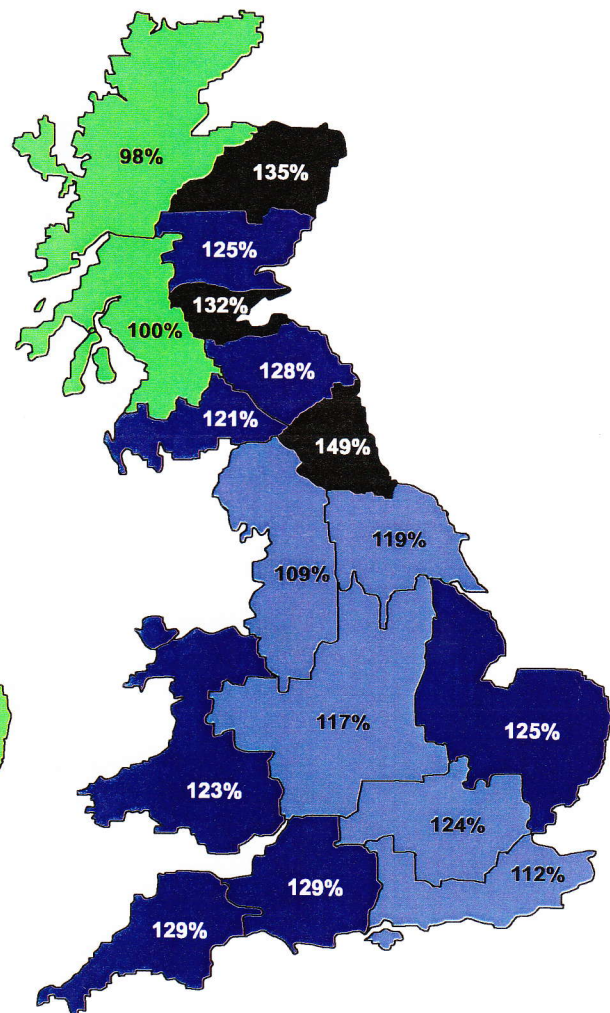
Rainfall . . . Rainfall . . . Rainfall

Key

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



July 1998 - September 1998

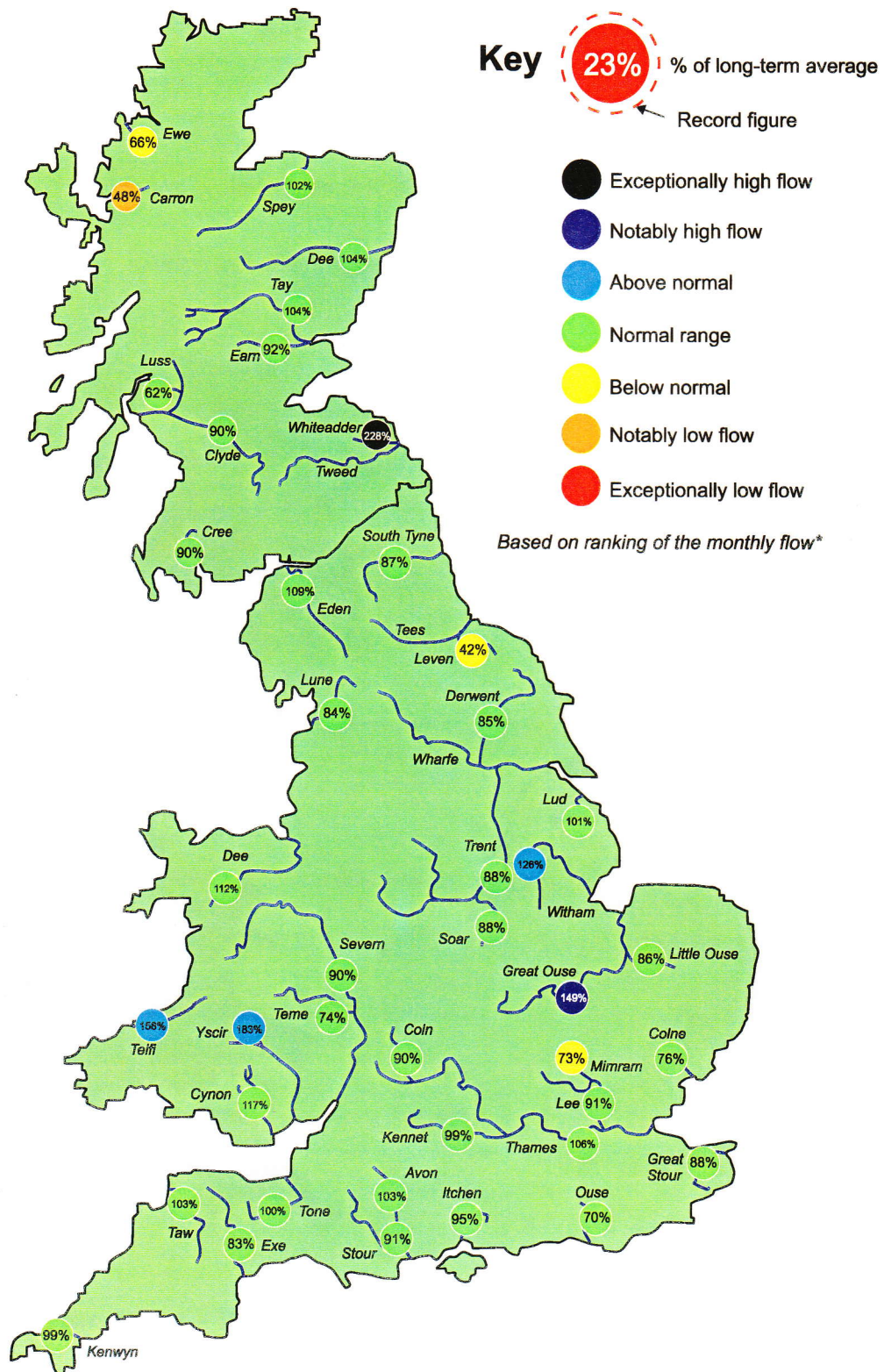


April 1998 - September 1998

Rainfall accumulation maps

Rainfall for Great Britain as a whole over the last three months is around 93% of the 1961-90 average. However, the April-September period is the third wettest summer half-year in the last 30 years - only 1992 and 1985 have produced higher rainfall totals.

River flow . . . River flow . . .

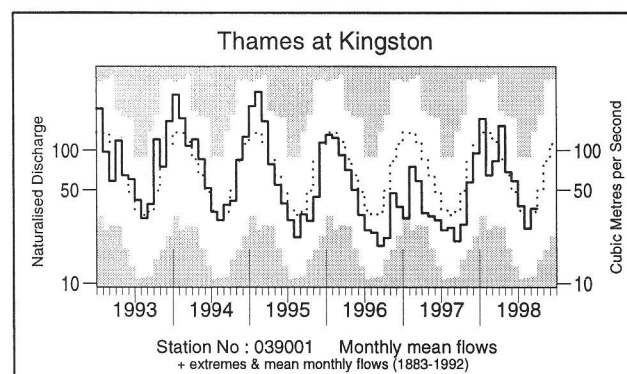
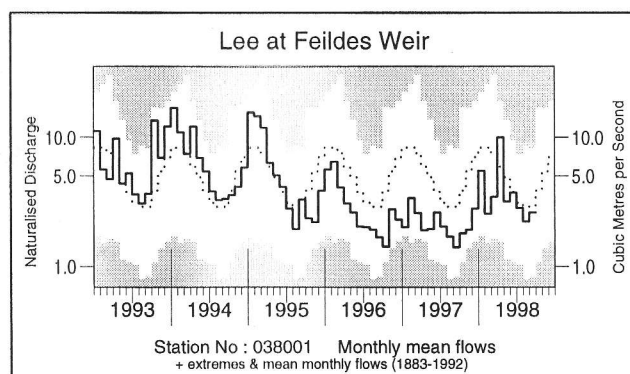
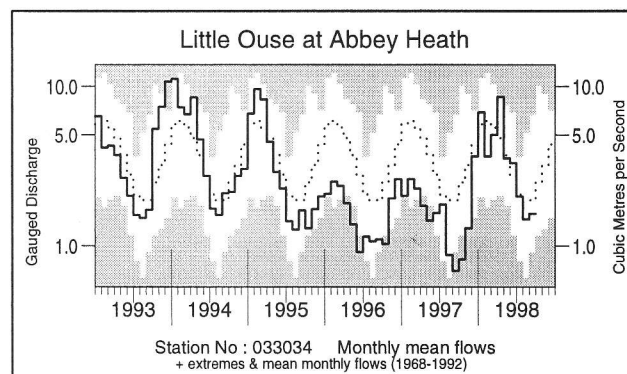
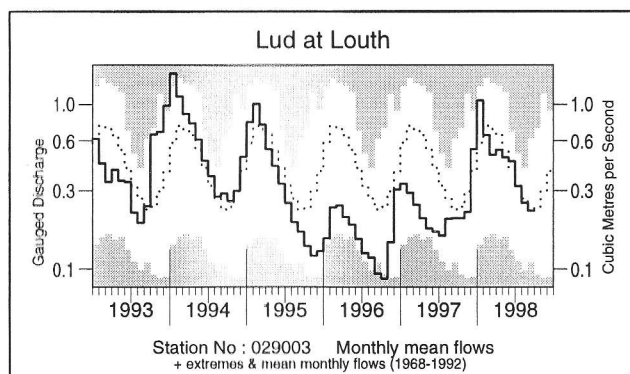
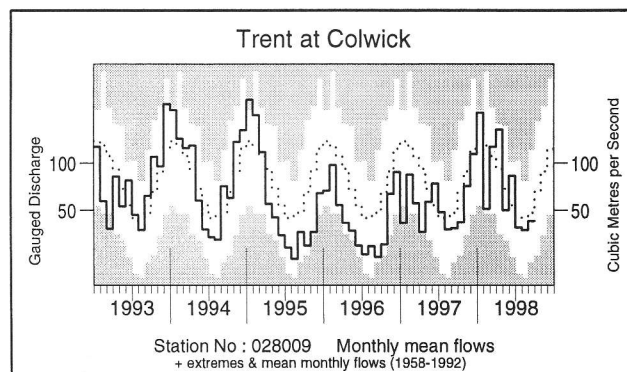
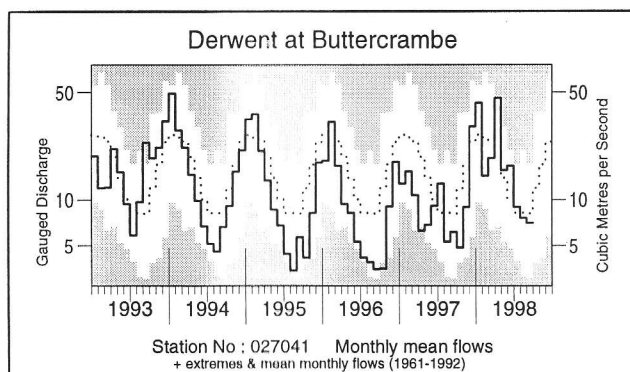
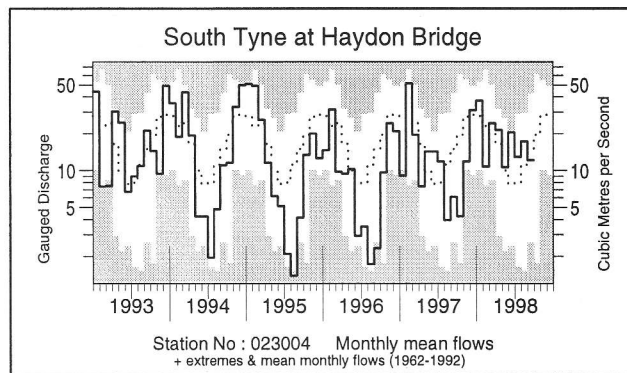
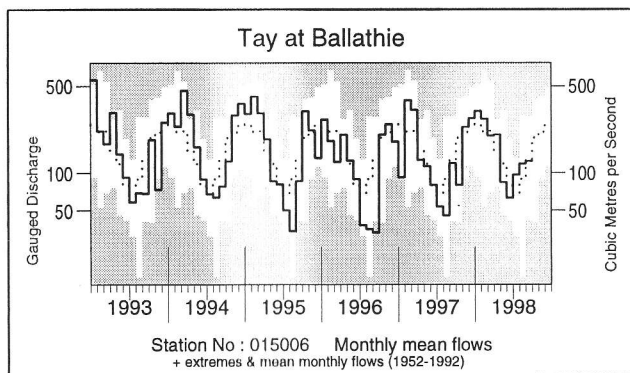


River flows - September 1998

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 . . .

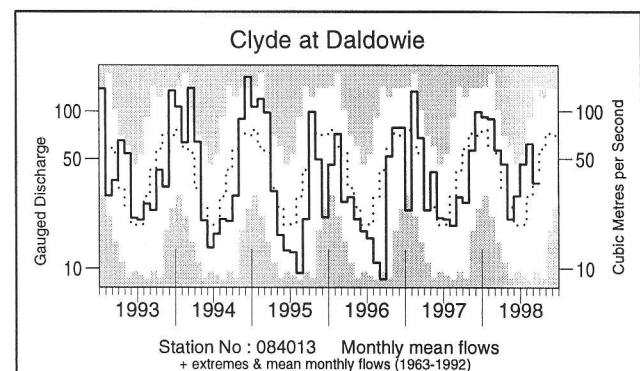
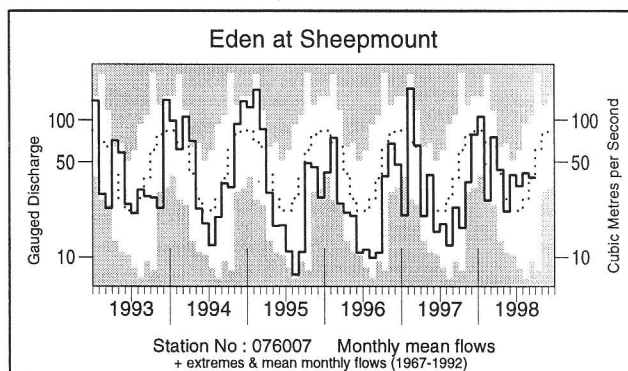
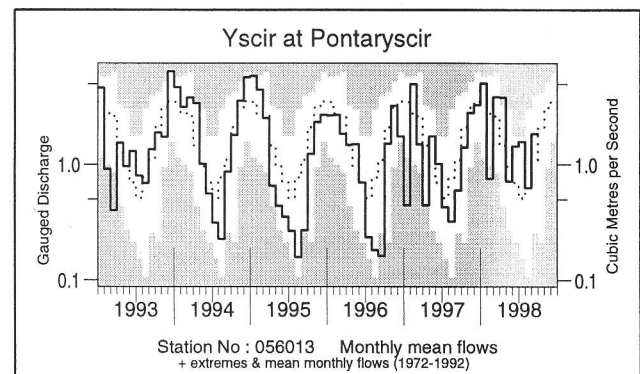
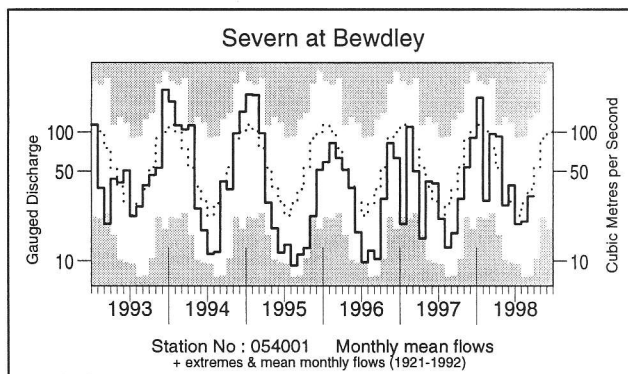
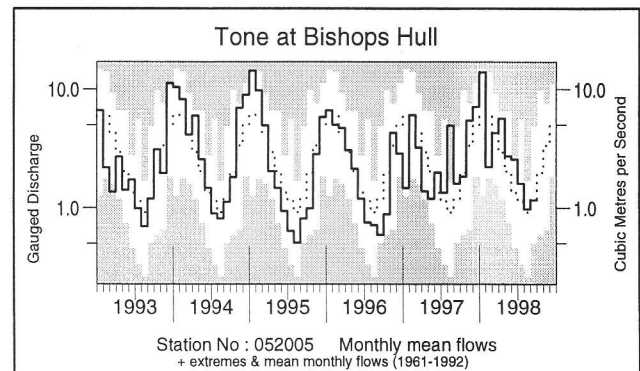
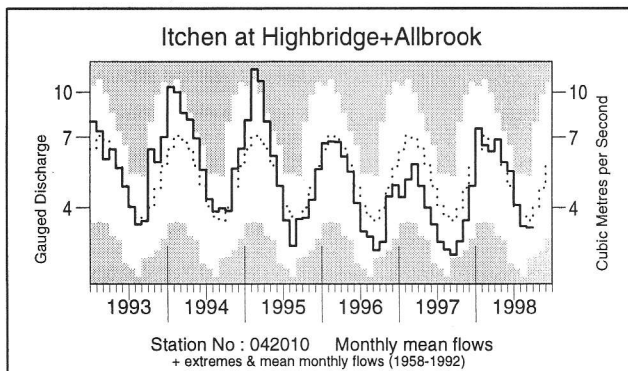
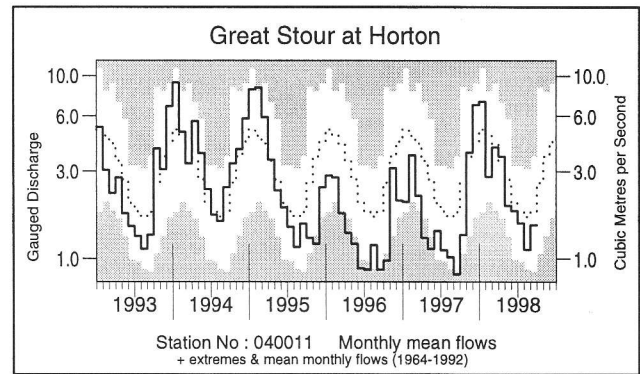
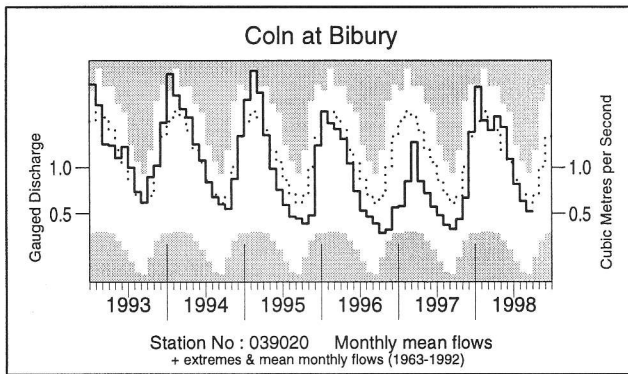
River flow . . .



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 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 . . .

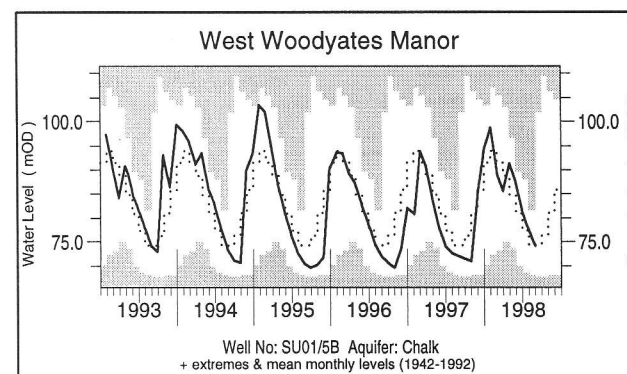
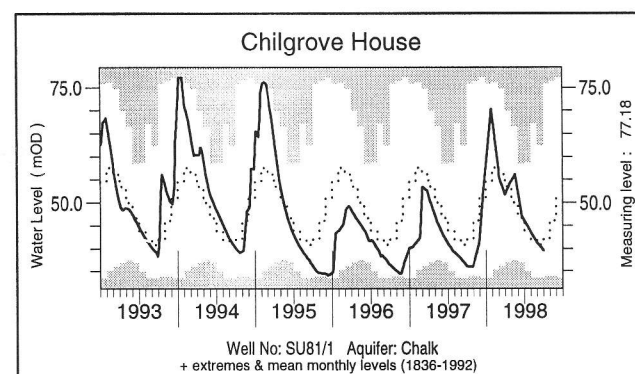
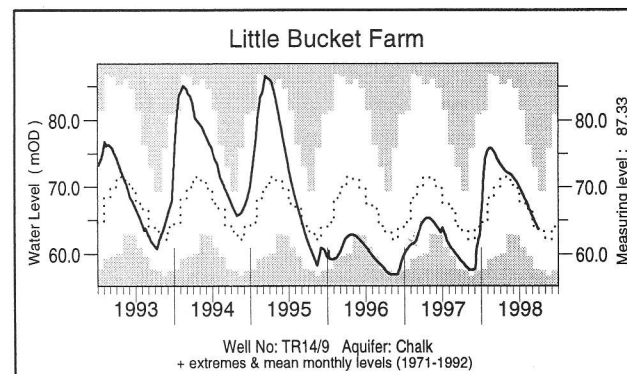
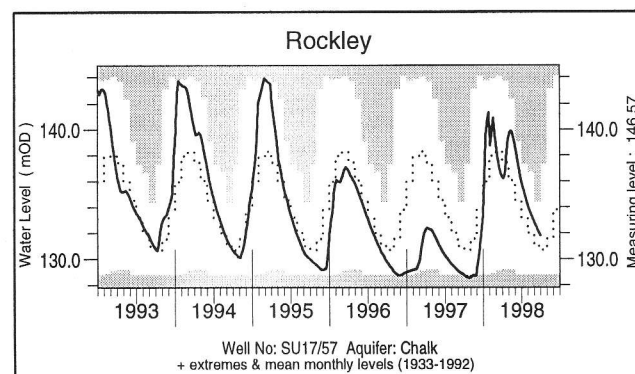
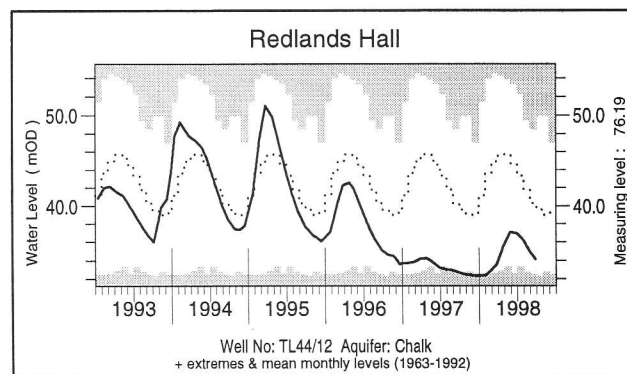
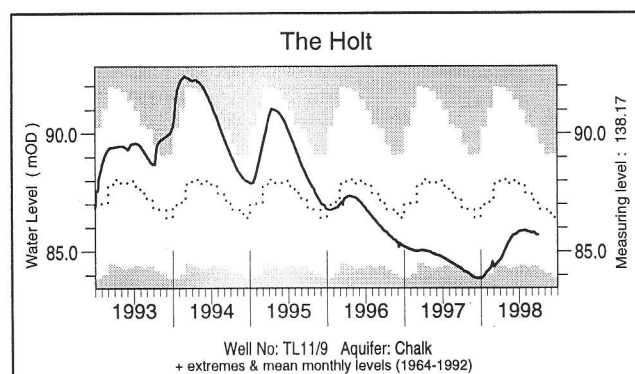
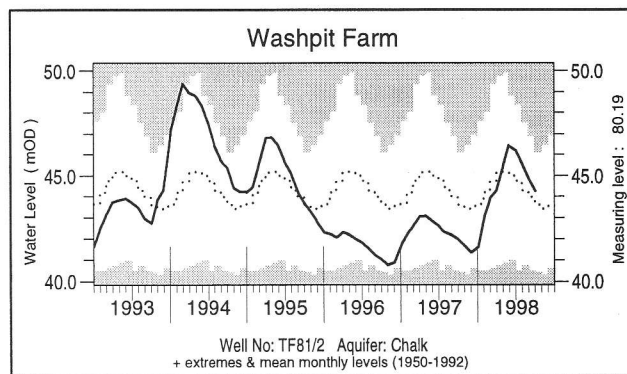
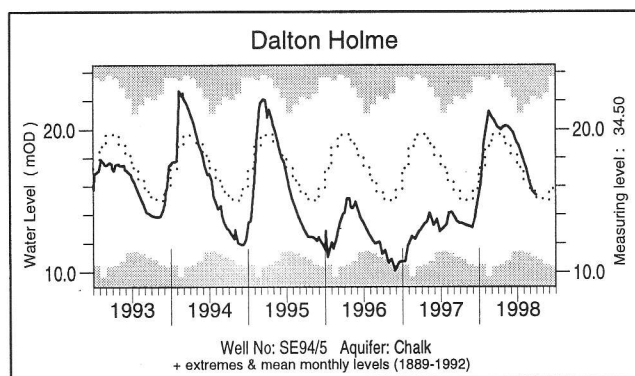


Notable runoff accumulations April 1998 - September 1998 (a); January 1998 - September 1998 (b)

(a) River	%lta	Rank	River	%lta	Rank	(b) River	%lta	Rank
Spey	131	41/46	Tone	151	37/38	Tweed	124	36/38
Tweed	103	37/38	Yscir	182	26/26	Witham	148	35/39
Derwent	237	66/66	Dee (Wales)	140	25/29	Tone	136	36/37
Mole	140	25/25	Clyde	145	33/35	Yscir	138	25/26
Ewe	158	41/42				Dee (Wales)	128	27/29
Taw	160	38/40				Carron	125	25/28

*lta = long term average
Rank 1 = lowest on record*

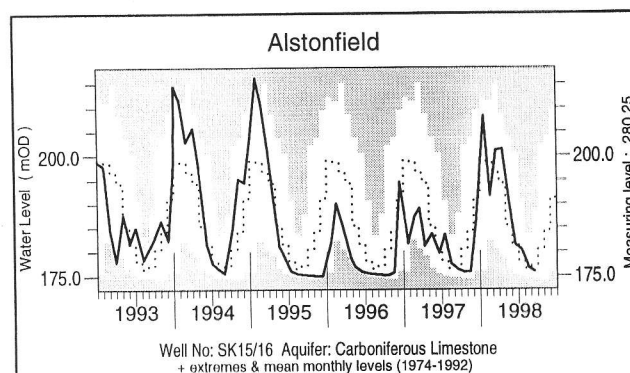
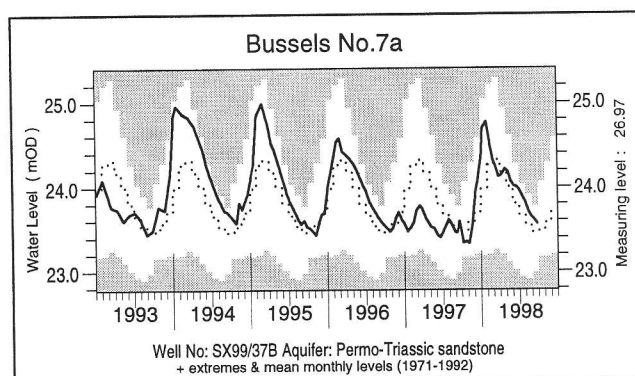
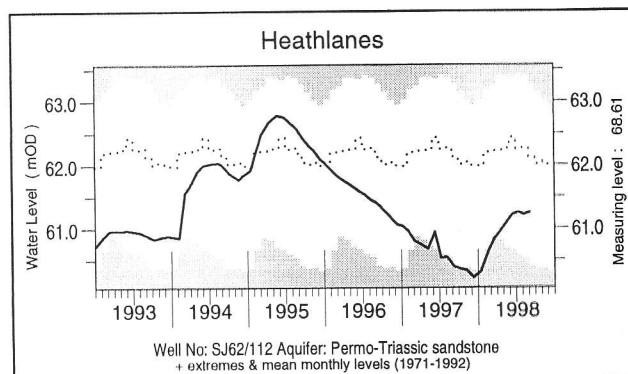
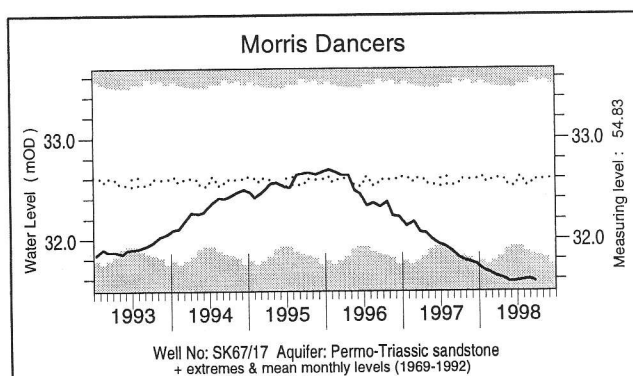
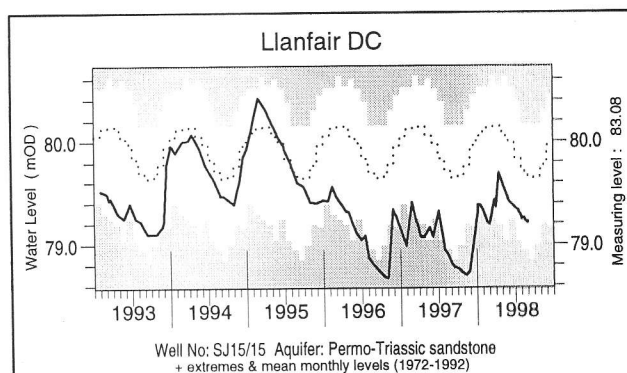
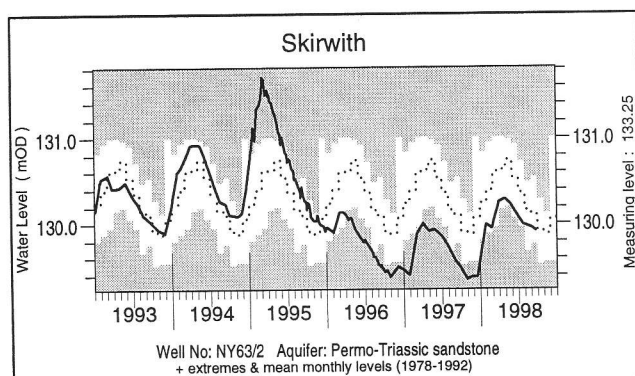
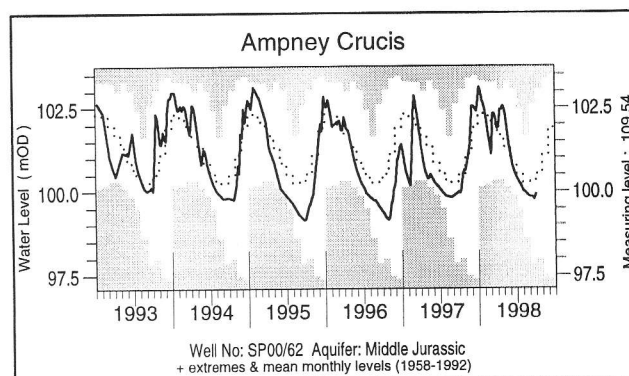
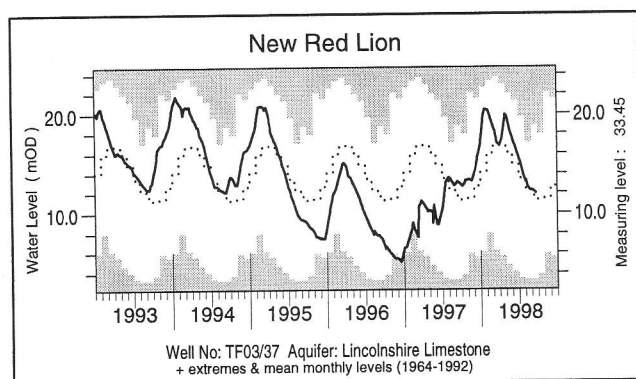
Groundwater . . . Groundwater



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.

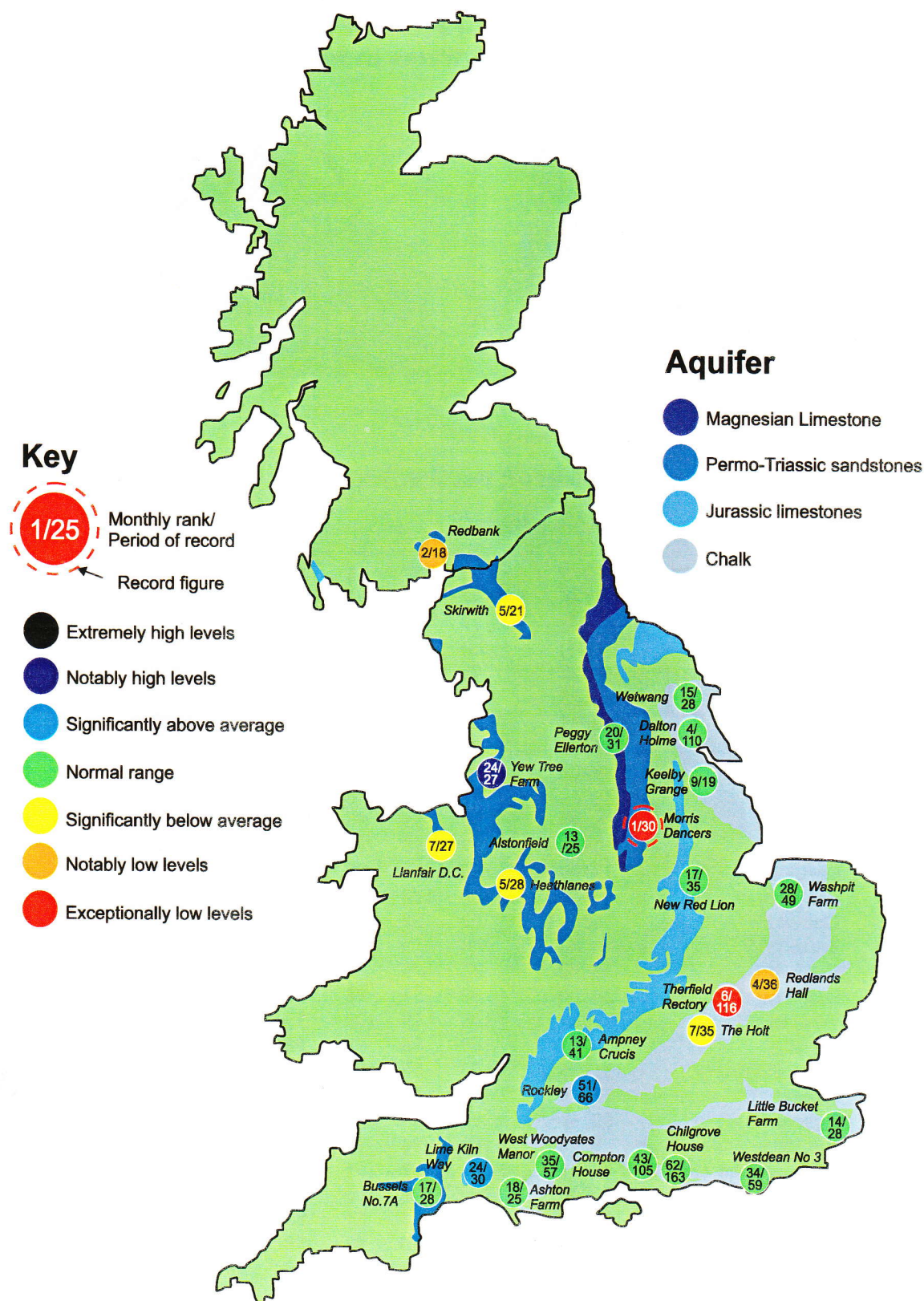
Groundwater . . . Groundwater



Groundwater levels September/October 1998

Borehole	Level	Date	Sep av.	Borehole	Level	Date	Sep av.	Borehole	Level	Date	Sep av.
Dalton Holme	15.33	29/09	15.45	Chilgrove	39.53	30/09	40.83	Llanfair DC	79.22	01/09	79.46
Washpit Farm	44.25	02/10	43.86	W Woodyates	74.03	31/08	73.11	Morris Dancers	31.58	23/09	32.46
The Holt	85.69	29/09	87.33	New Red Lion	11.93	21/09	11.52	Heathlanes	61.25	05/09	61.99
Redlands Hall	34.09	25/09	39.54	Ampney Crucis	99.90	29/09	100.15	Bussels	23.56	24/09	23.48
Ashton Farm	65.60	31/08	65.15	Skirwith	129.91	22/09	130.07	Alstonfield	175.78	19/08	176.84
Little Bucket	63.63	28/09	64.44								

Groundwater . . . Groundwater

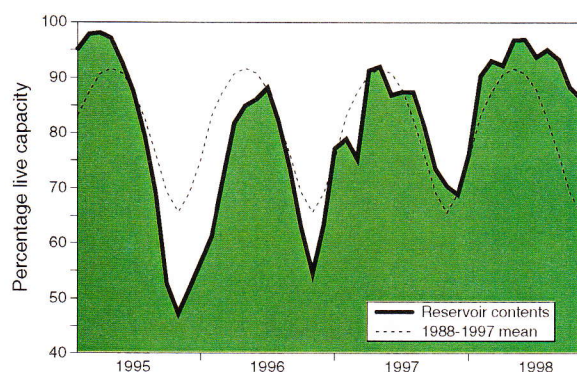


Groundwater levels - September 1998

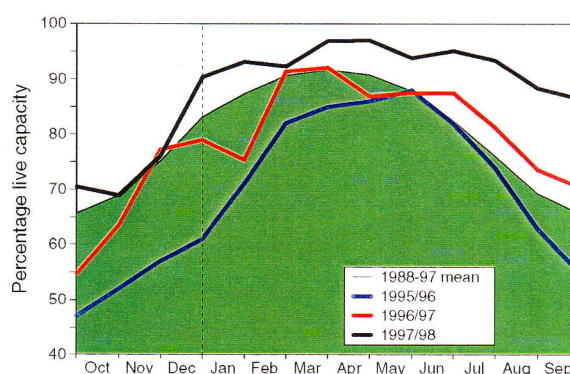
The rankings are based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. Caution needs to be exercised when interpreting the ranking, especially during periods of rapid changes in groundwater level. Rankings may be omitted where they are considered misleading.

Reservoirs . . . Reservoirs . . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs

Area	Reservoir	Capacity (MI)	1998						Min. Oct	Year* of min
			May	Jun	Jul	Aug	Sep	Oct		
NorthWest	N Command Zone	• 133375	93	87	85	84	80	75	13	1995
	Vyrnwy	55146	97	95	93	90	81	83	26	1995
Northumbrian	Teesdale	• 87936	97	90	90	90	92	87	31	1995
	Kielder	(199175)	(95)	(92)	(93)	(92)	(94)	(88)	(59)	1989
SevernTrent	Clywedog	44922	99	98	98	97	93	88	24	1989
	DerwentValley	• 39525	99	90	100	93	96	90	24	1989
Yorkshire	Washburn	• 22035	95	91	98	89	85	82	24	1995
	Bradford supply	• 41407	99	93	96	93	92	92	15	1995
Anglian	Grafham	58707	92	99	96	95	87	84	46	1997
	Rutland	130061	98	96	96	93	88	86	61	1995
Thames	London	• 206399	98	99	99	96	85	82	53	1997
	Farmoor	• 13843	97	99	98	96	97	98	60	1990
Southern	Bewl	28170	100	96	92	86	76	70	32	1990
	Ardingly	4685	100	100	100	96	74	67	37	1996
Wessex	Clatworthy	5364	92	88	92	87	77	70	30	1995
	BristolVWV	• (38666)	(98)	(91)	(92)	(88)	(79)	(72)	(31)	1990
SouthWest	Colliford	28540	77	76	77	78	76	76	43	1997
	Roadford	34500	98	97	98	99	98	96	26	1995
	Wimbleball	21320	100	99	100	99	92	87	30	1995
	Stithians	5205	100	98	92	88	80	71	22	1990
Welsh	Celyn and Brenig	• 131155	100	98	100	100	84	95	39	1989
	Brianne	62140	100	94	99	100	100	97	48	1995
	Big Five	• 69762	99	91	98	97	88	94	19	1995
	Elan Valley	• 99106	100	93	98	98	96	97	34	1995
East of Scotland	Edinburgh/Mid Lothian	• 97639	62	52	54	51	45	43**	64	1995
	East Lothian	• 10206	100	99	100	100	99	100	52	1989
West of Scotland	Loch Katrine	• 111363	99	90	81	85	89	85	43	1995
	Daer	22412	100	90	95	98	87	81	32	1995
	LochThom	• 11840	100	92	90	100	98	97	56	1995

() figures in parentheses relate to gross storage

• denotes reservoir groups

* last occurrence

** Megget drawdown for maintainence

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 1988-1998 period only. In some gravity-fed reservoirs (eg. Clywedog) stocks are kept below capacity during the winter to provide scope for flood

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 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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Institute of Terrestrial Ecology
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