Hydrological Summary
for the United Kingdom

August 2007

General

August saw the end of the exceptional cyclonicity which produced outstanding late spring and early summer rainfall across much of southern Britain. August rainfall totals, though spatially very variable, were generally within the normal range. Nonetheless, the UK registered its wettest summer (June-August) in a series from 1914. Correspondingly, runoff totals for the summer were outstanding across much of the country with river flow patterns more typical of the winter. Importantly, appreciable soil moisture deficits have developed over the last six weeks, moderating the flood risk which, remarkably, was high over wide areas at the beginning of August. Entering the autumn, overall reservoir stocks for England & Wales were the 2nd highest in a 20-yr record; most reservoir levels being well above the monthly average. With exceptionally high August groundwater levels characterising many aquifer outcrop areas, the groundwater resources outlook is also very healthy. However, the normal (November-April) recharge season is very likely to begin with seasonally elevated groundwater levels in many areas. Correspondingly, an enhanced risk of groundwater flooding may be expected to persist through the late autumn and winter – much will depend on the spatial and temporal distribution of rainfall over the next six months.

Rainfall

The relentless passage of low pressure systems, across southern Britain especially, eased in August although the mid-month period was unsettled and a preponderance of northerly airflows often gave the weather an autumnal complexion. Vigorous frontal systems produced notable storm totals in western Scotland (Kinlochewe recorded 69mm on the 7th and 56mm on the 13th) and a number of locally intense storms were reported (e.g. 40mm in 5hrs at Brixham on the 21st) but flash flooding incidents were much rarer than in June and July. A protracted dry spell developed in southern Britain as anticyclonic conditions became established. In parts of central southern England accumulated rainfall totals, from the 22nd, remained below 5mm for 20 or more days. This dry spell contributed to August rainfall totals well below average in a broad zone from the North East to the Bristol Channel. By contrast, parts of the Scottish Highlands approached twice the 1961-90 average; some catchments reporting their wettest August for 15 years. Notwithstanding the limited August rainfall in many central areas, the summer rainfall for England & Wales was the highest since 1912 (notably wet summers were rather more common in the 19th century). National and regional rainfall accumulations are exceptional across a range of durations. Remarkably, the September-August period is the wettest 12-month sequence (for any start month) on record for Scotland; in this timeframe very large positive anomalies characterise most regions of Great Britain.

River flows

August began with many catchments exceptionally vulnerable to further significant rainfall; a very rare circumstance given the number of major basins involved. Some notable summer spates were reported (e.g. on the Ewe, Taw, and Dorset Stour) and isolated intense storms overwhelmed local drainage capacities (e.g. in Torbay) but, generally, the month was characterised by steep and sustained recessions in responsive rivers (northern Scotland excepted). After the exceptional July flooding, flows in the Severn declined to below the early September average. By contrast, flows in spring-fed rivers – benefiting from the lagged impact of the earlier summer rainfall – followed shallow recessions and remained exceptionally high. Most index rivers registered well above average August runoff totals with new monthly maxima common in central southern England – including the Thames in a series from 1883. Runoff in much of Scotland has been abundant over the last year – for the Naver and Nevis the Sept-Aug runoff is the highest for *any* 12-month sequence on record – but the most outstanding runoff totals relate to the June-August timeframe. Summer runoff in 2007 exceeded previous maxima for a majority of UK index rivers, in many cases by wide margins. June-August runoff for the Lud was more than twice the previous maximum in a 40-yr series – an appropriate coda for a remarkable summer.

Groundwater

The development of soil moisture deficits through August served to terminate an extraordinary summer recharge episode. By month end, deficits remained 30-60 mm below average over wide areas (for E&W as a whole, soils were wetter only in 1966 and 2004) but deficits continued to increase in early September. The associated cessation of recharge is clearly evident in the groundwater level hydrographs for a number of responsive aquifers (including the Jurassic and Carboniferous Limestones). Elsewhere, groundwater levels increased in August as water in the unsaturated zone reached the water-tables. In the Chalk of the Yorkshire and Lincolnshire Wolds, new maximum August levels were reported for Aylesby, Wetwang and Dalton Holme, the latter in a series from 1889 (only 1912 shows a comparable response). Levels were also outstanding in the most south-westerly outcrops and at typical winter levels in parts of the Berkshire Downs. The full effect of the pulse of June/July recharge has yet to register on the hydrographs for many slower-responding units of the Chalk (see the hydrograph for Tilshead). However, the lower summer rainfall is also a factor in relation to the less seasonally extreme late-summer groundwater levels across much of the South East. Levels are now rising briskly in the slow-responding Permo-Triassic sandstones of the Midlands – after several years of depressed levels. In some parts of the Chalk, notably in the northern and western outcrops, there has been sufficient recharge to raise groundwater levels to a point where groundwater flooding is a possibility this winter. Whether flooding actually occurs will be influenced not only by rainfall patterns but also by local aquifer properties (there is, for example, little historical evidence of groundwater flooding in the Yorkshire Wolds).

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Aug 2007	Jun 07-Aug 07	RP	May 07-Aug 07	RP	Jan 07-Aug 07	RP	Oct 06-Aug 07	RP
England & Wales	**mm**	**59**	**345**		**456**		**742**		**1100**	
	%	**78**	**170**	**>100**	**171**	**>100**	**134**	**35-50**	**133**	**70-100**
North West	mm	**82**	432		521		879		1405	
	%	**75**	155	30-45	147	30-40	122	5-15	128	30-40
Northumbrian	mm	**52**	340		412		659		954	
	%	**62**	161	30-50	150	30-50	121	5-15	120	10-20
Severn Trent	mm	**40**	352		461		707		984	
	%	**58**	191	>>100	189	>>100	145	>100	140	>100
Yorkshire	mm	**44**	372		449		694		976	
	%	**58**	186	50-100	172	>100	132	20-35	128	20-35
Anglian	mm	**53**	264		378		545		731	
	%	**96**	168	50-80	183	>>100	140	50-80	132	30-50
Thames	mm	**51**	269		390		612		894	
	%	**86**	164	30-45	177	>100	139	30-45	139	70-100
Southern	mm	**52**	266		365		608		933	
	%	**90**	165	30-50	169	>100	130	10-20	130	20-35
Wessex	mm	**52**	299		424		704		1070	
	%	**76**	167	30-50	176	>100	135	20-30	137	50-80
South West	mm	**88**	365		523		969		1450	
	%	**101**	160	30-45	174	>100	136	30-40	132	30-50
Welsh	mm	**82**	463		592		1043		1655	
	%	**77**	173	>100	168	>100	132	20-35	135	70-100
Scotland	**mm**	**146**	**392**		**528**		**1090**		**1789**	
	%	**125**	**132**	**5-15**	**137**	**30-50**	**128**	**30-50**	**135**	**>>100**
Highland	mm	**184**	403		587		1321		2199	
	%	**142**	120	5-10	137	20-35	134	70-100	140	>>100
North East	mm	**107**	364		481		801		1201	
	%	**118**	154	40-60	155	50-100	127	20-30	128	40-60
Tay	mm	**118**	421		530		1027		1664	
	%	**118**	163	50-80	154	50-80	133	30-45	143	>>100
Forth	mm	**120**	372		464		899		1465	
	%	**123**	151	30-50	144	30-45	132	30-50	142	>>100
Tweed	mm	**82**	356		450		1761		1167	
	%	**92**	153	30-45	147	30-50	123	10-20	128	30-50
Solway	mm	**124**	435		542		1014		1684	
	%	**102**	145	20-30	140	20-35	121	5-15	130	50-80
Clyde	mm	**154**	400		532		1205		2063	
	%	**108**	114	2-5	119	5-10	120	10-20	132	>100
Northern Ireland	**mm**	**98**	**377**		**451**		**776**		**1170**	
	%	**103**	**157**	**30-50**	**144**	**20-35**	**116**	**5-10**	**117**	**5-10**

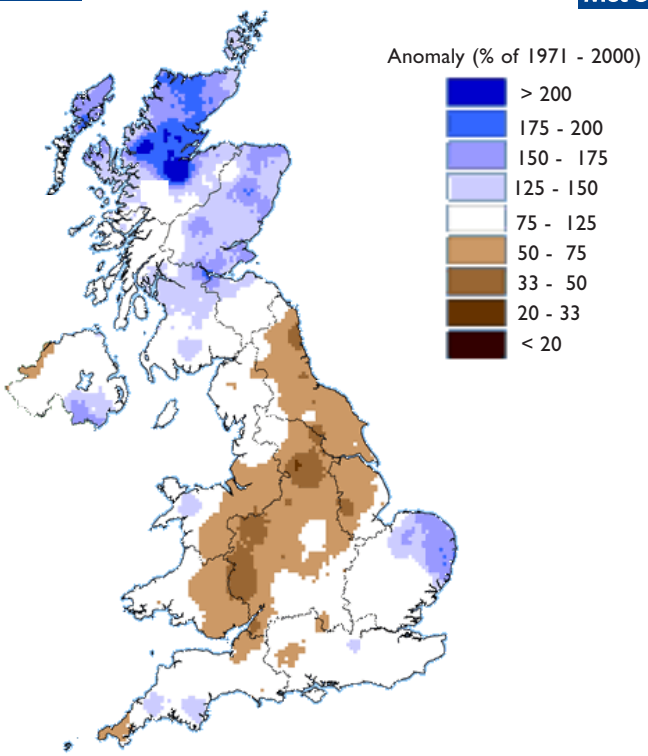
% = percentage of 1961-90 average *RP = Return period*

Important note: Figures in the above table may be quoted provided that their source is acknowledged. See page 12. Where appropriate, specific reference must be made to the uncertainties associated with the return period estimates. Generally, the return period estimates are based on tables provided by the Met Office* but those for Northern Ireland are based on the estimates for north-west England. The estimates relate to the specified region and span of months only (RPs may be an order of magnitude less if n-month periods beginning in any month are considered), they reflect rainfall variability over the period 1911-70 only, and assume a stable climate. (For further details see Tabony, R. C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37). The timespans featured do not purport to represent the critical periods for any particular water resource management zone and, normally, for hydrological or water resources assessments of drought severity, river flows and groundwater levels provide a better guide than return periods based on rainfall totals. *In some cases ranking positions of accumulated rainfalls are also considered.

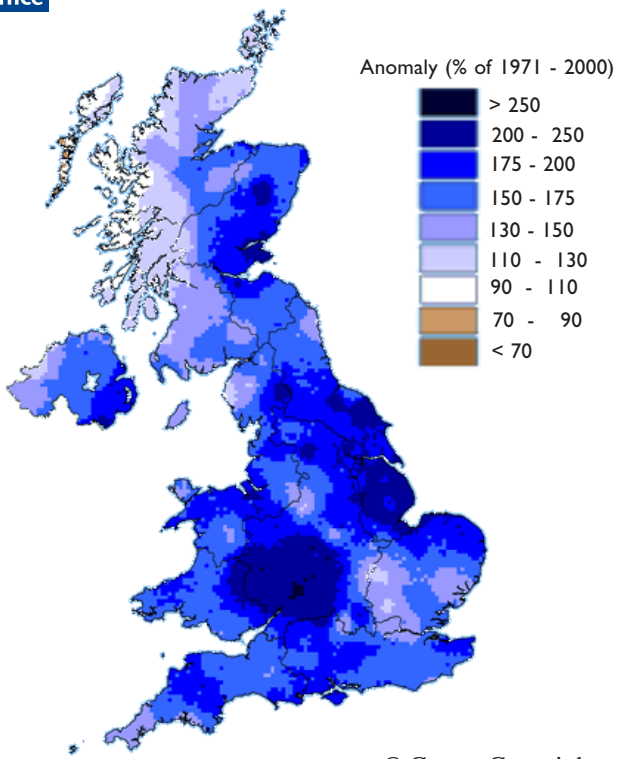
All monthly rainfall totals since March 2007 are provisional.

Rainfall . . . Rainfall . . .

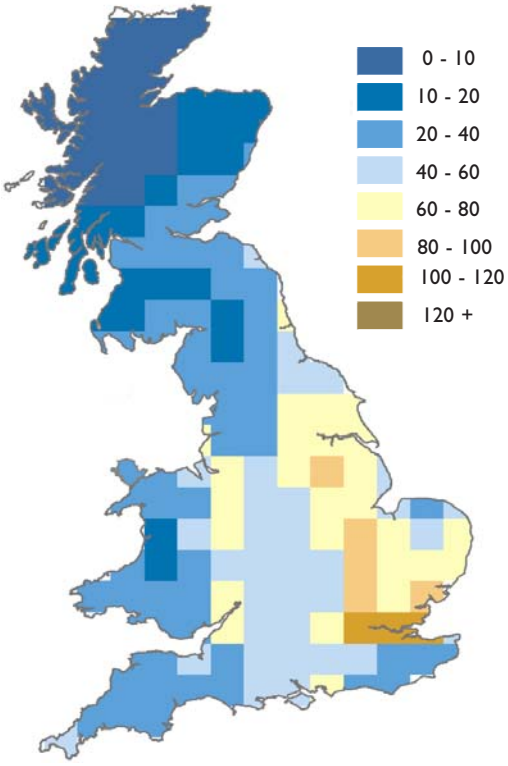
Rainfall anomaly August 2007



Rainfall anomaly June - August 2007



Soil Moisture Deficit (mm) August 2007



Met Office Autumn 2007 forecast

This forecast for Autumn 2007 has been derived using global forecasting models and statistical methods. Autumn in this context is defined as the months of September, October and November.

Forecast for Autumn 2007 issued on 23 August 2007

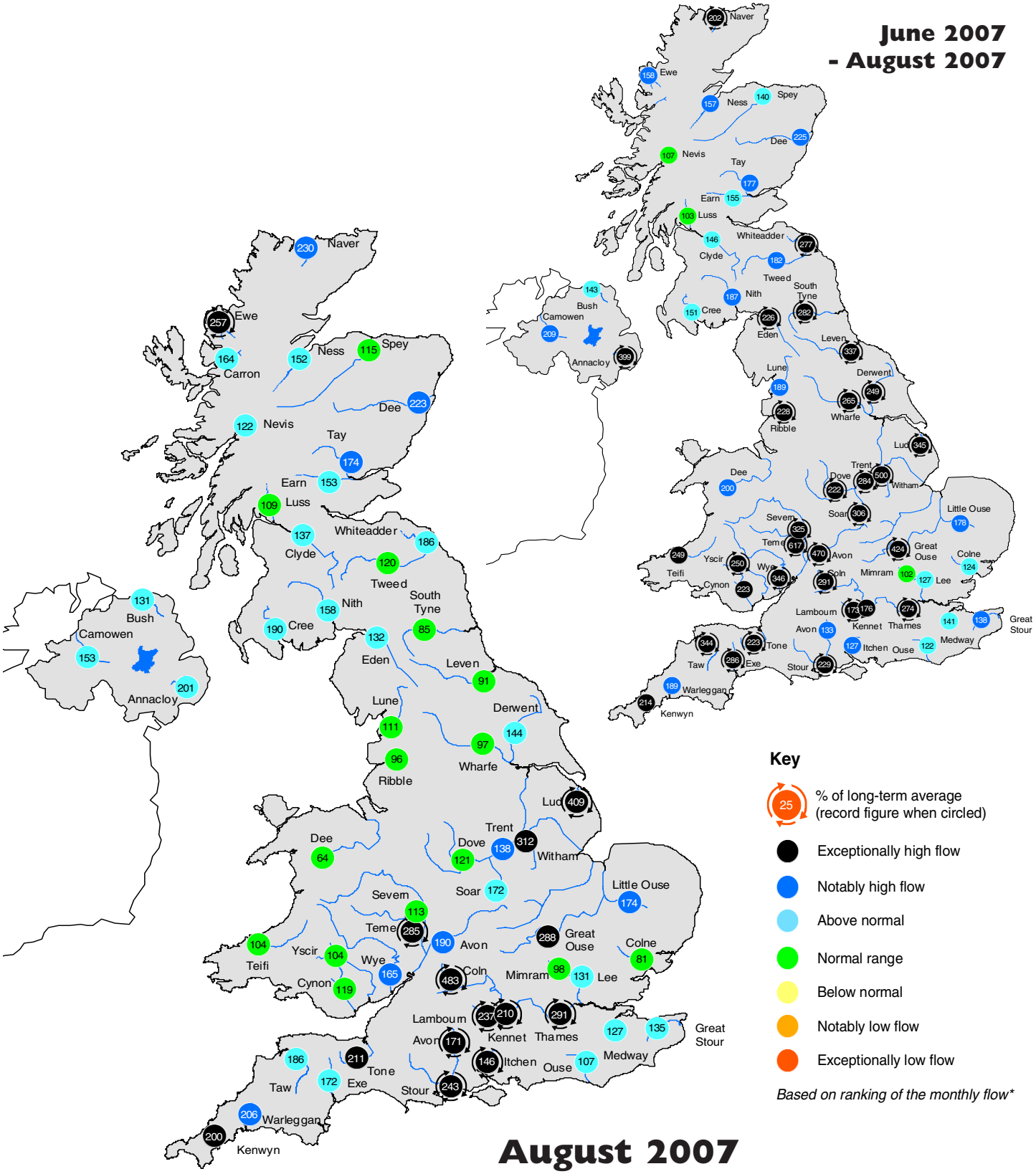
Our forecasting methods indicate that high pressure systems to the west of the British Isles may be more frequent than is usually the case in autumn. This suggests the following outlook for the UK for Autumn 2007.

- Most likely to be warmer than the 1971-2000 average, though cooler than last autumn
- Average or below-average rainfall is more likely rather than above-average rainfall
- Less frequent periods of very windy weather for autumn as a whole
- Greater risk of fog, compared to normal, during the latter part of autumn

The autumn forecast will next be updated at 10 a.m. on 25 September 2007.
For further details please visit:
http://www.metoffice.gov.uk/weather/seasonal/autumn2007/index.html

The rainfall maps are provisional and based on a limited number of raingauges (the August map in particular). The soil moisture deficit map is based on MORECS (see page 12) and assumes a grass cover. End-of-August deficits were 40-80mm below average across large parts of England

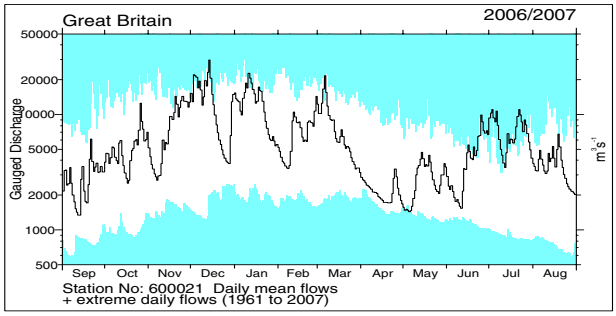
River flow . . . River flow . . .

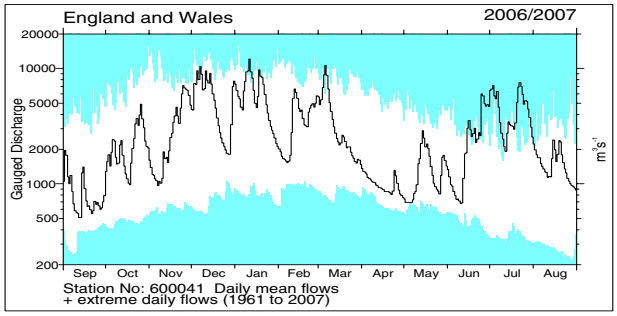


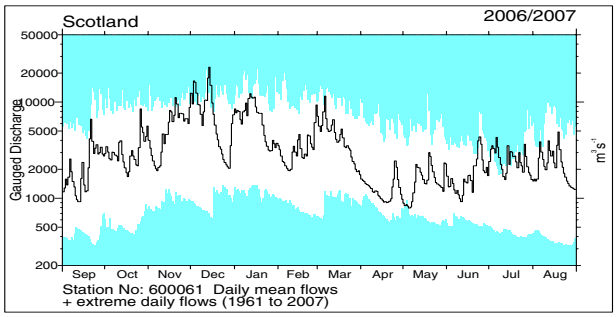
River flows

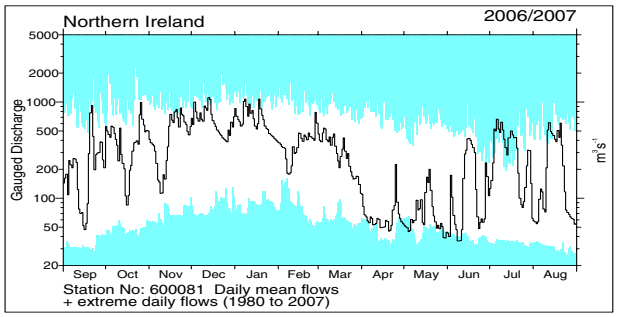
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station. Percentages may be omitted where flows are under review.

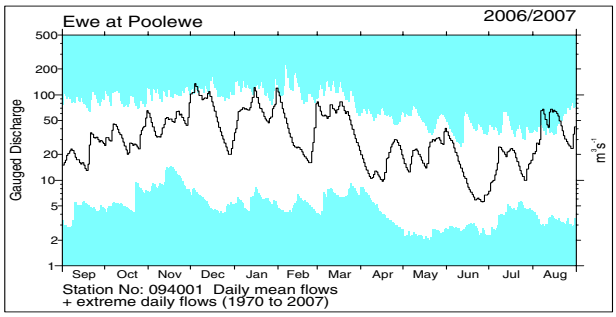
River flow . . . River flow . . .

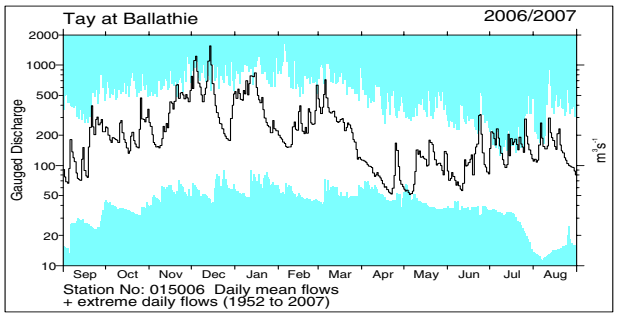


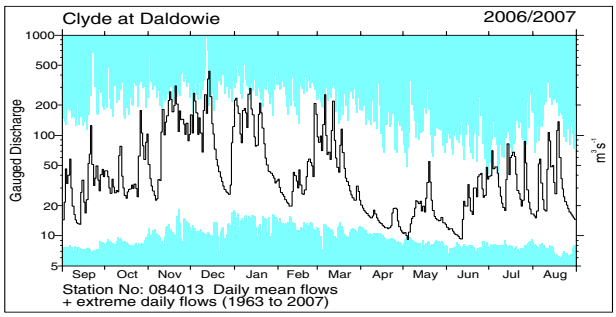


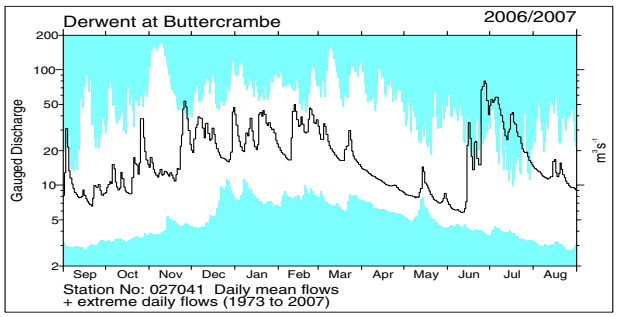


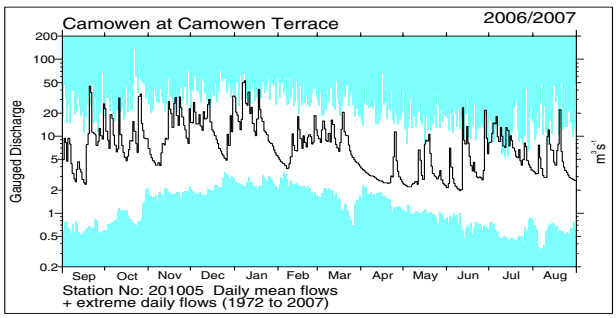


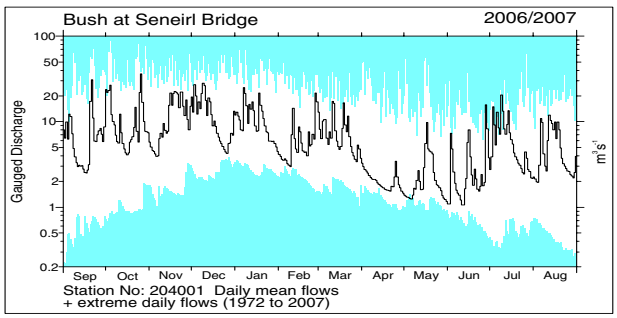








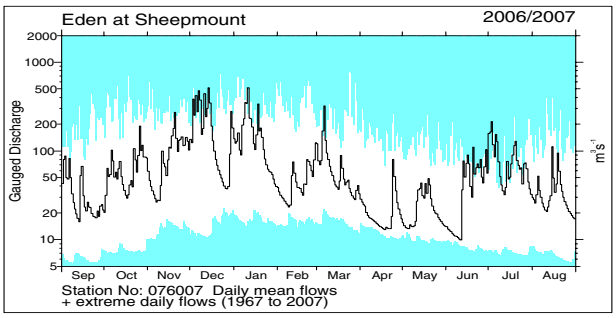


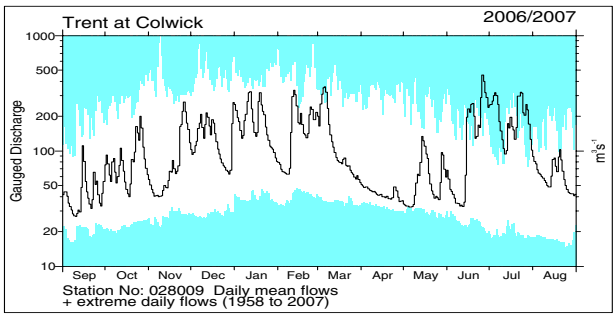


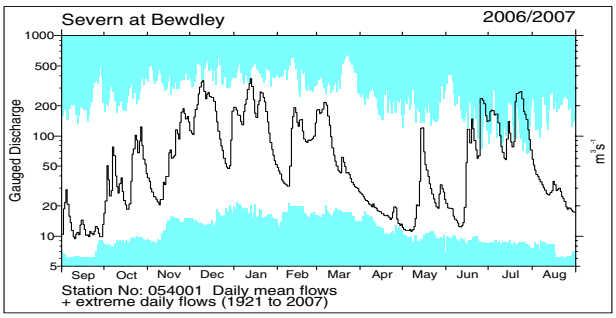
River flow hydrographs

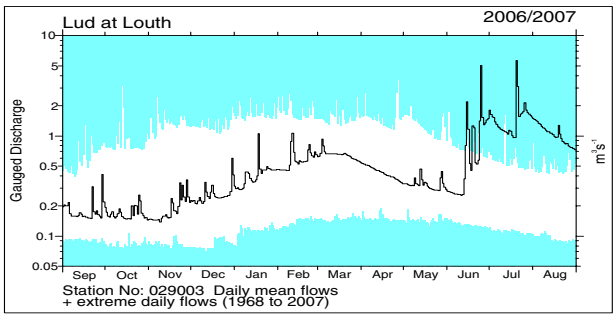
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to September 2006 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

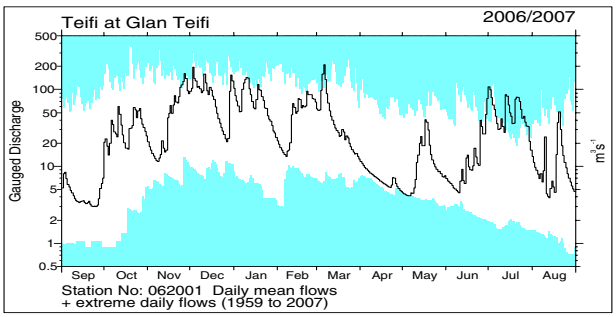
River flow . . . River flow . . .

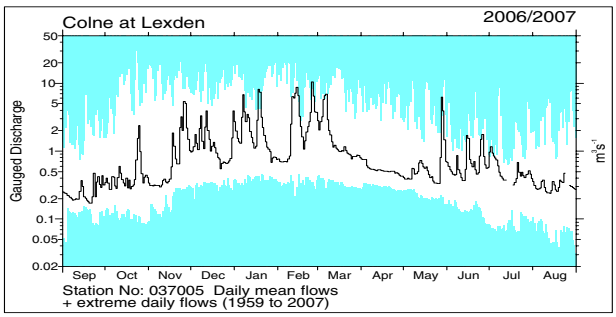


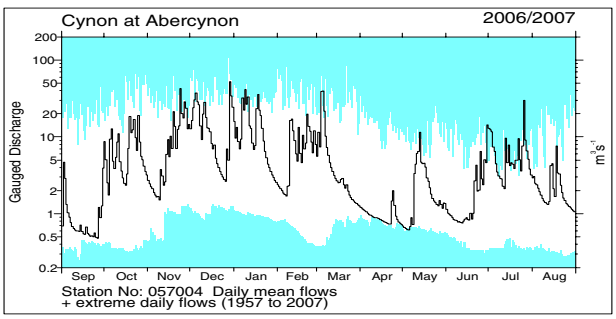


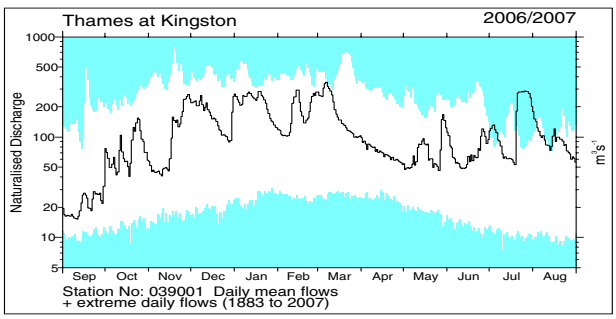


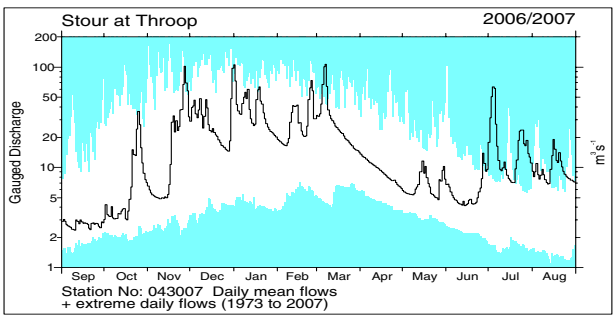


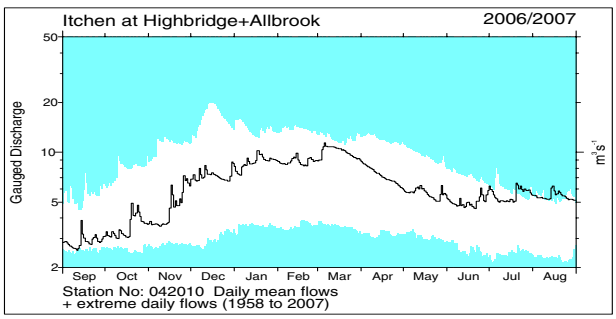










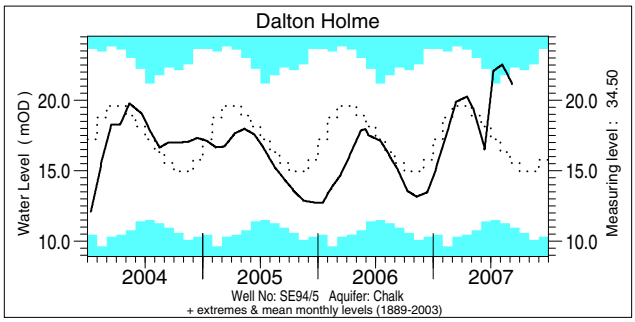


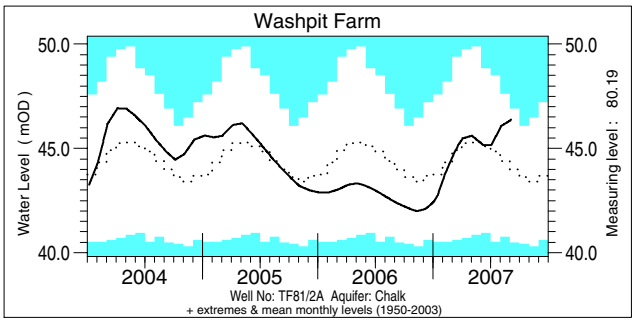
Notable runoff accumulations (a) June - August 2007, (b) October 2006 - August 2007

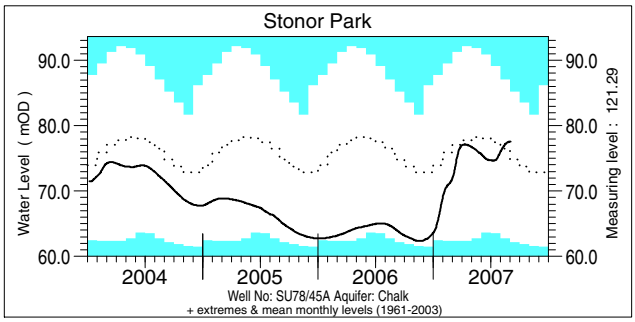
	River	%lta	Rank
a)	Whitadder	277	38/38
	Tyne (Bywell)	280	49/49
	Wharfe	265	52/52
	Trent	284	49/49
	Witham	500	49/49
	Ouse (Bedford)	424	75/75
	Thames	274	125/125
	Blackwater	197	55/55
	Lymington	345	45/45
	Exe	286	52/52
	Severn	325	87/87
	Avon (Evesham)	470	71/71
	Teme	617	38/38
	Wye	346	71/71
	Ribble	228	48/48
	Lagan	330	35/35
	Annacloy	399	28/28
b)	Tay	145	55/55
	Forth	123	26/26
	Tweed (Boleside)	130	46/46
	Cynon	152	49/49
	Nith	137	50/50
	Ewe	131	36/36
	Camowen	134	34/34

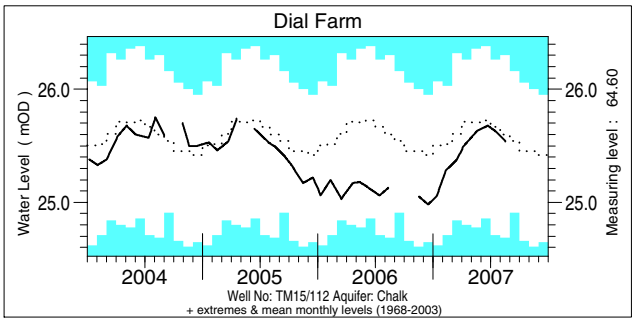
lta = long term average
Rank 1 = lowest on record

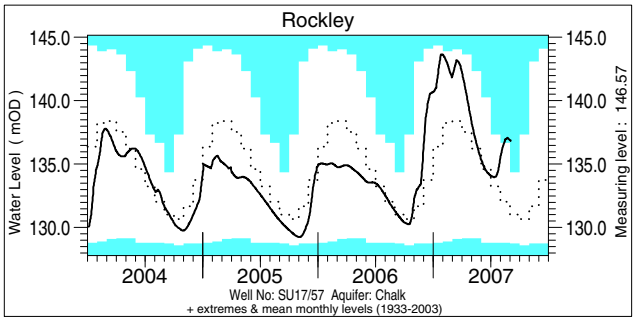
Groundwater . . . Groundwater

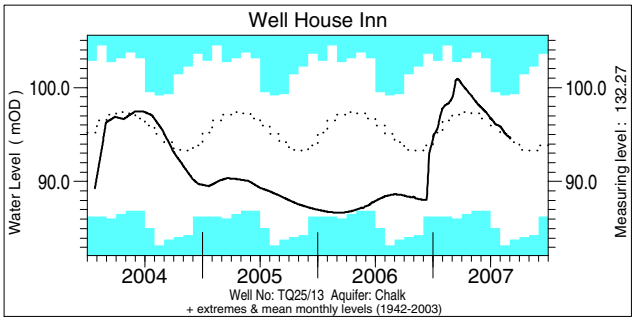


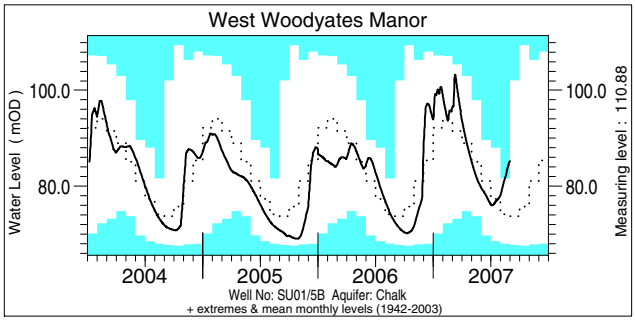


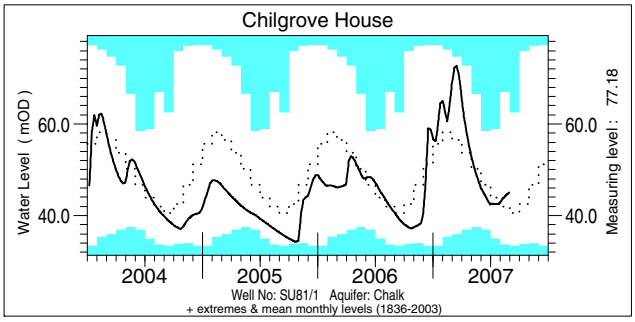


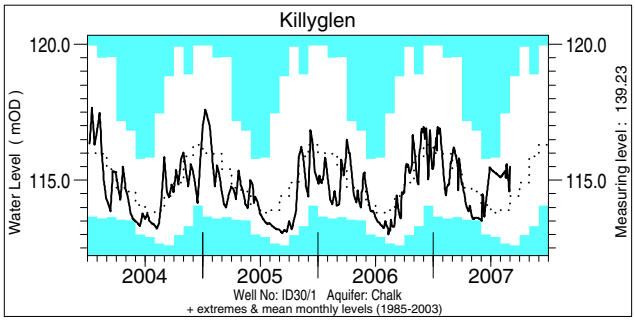


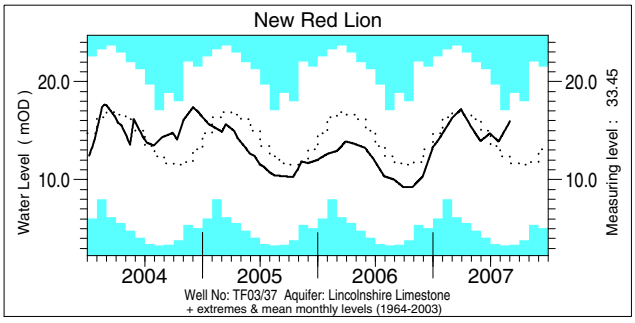






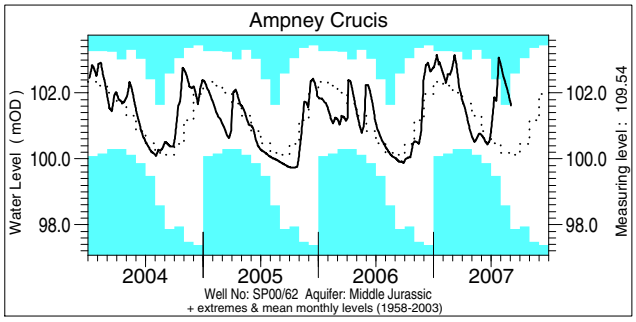


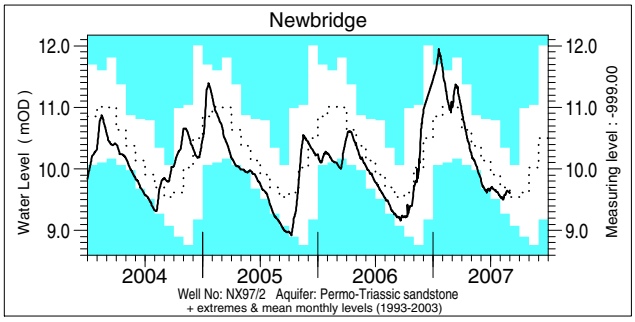


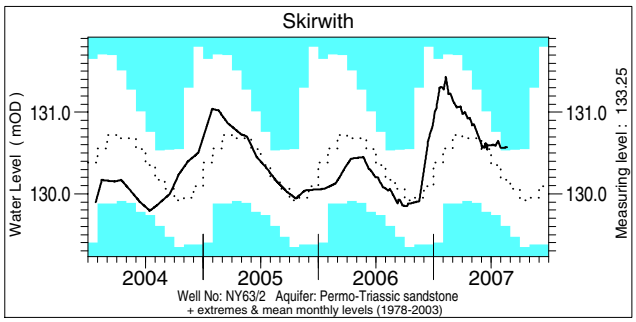


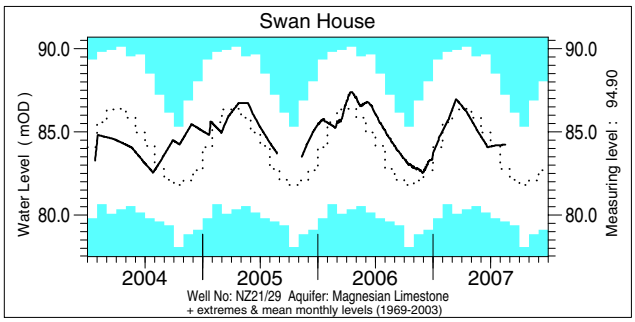
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month 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.

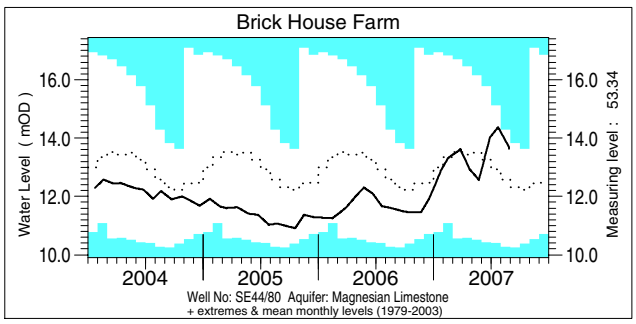
Groundwater . . . Groundwater

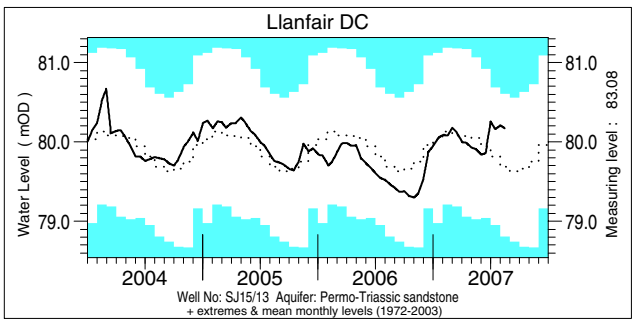


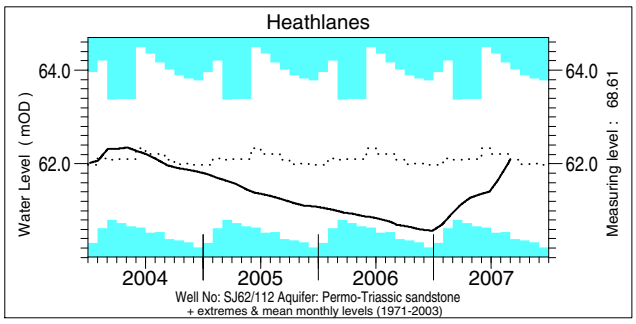


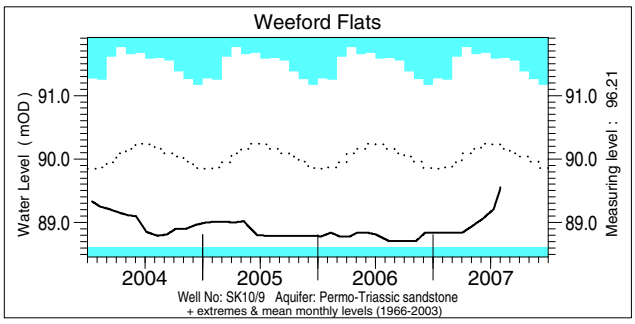


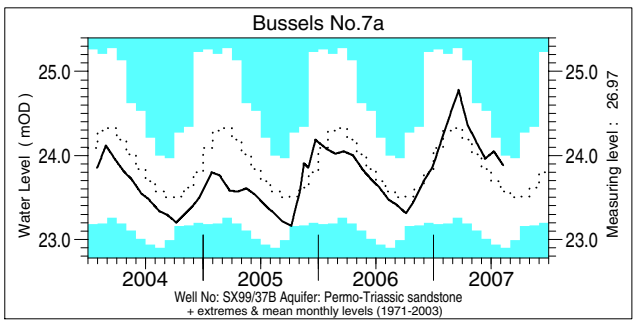


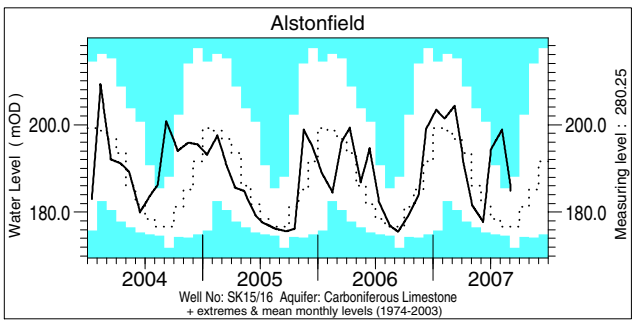










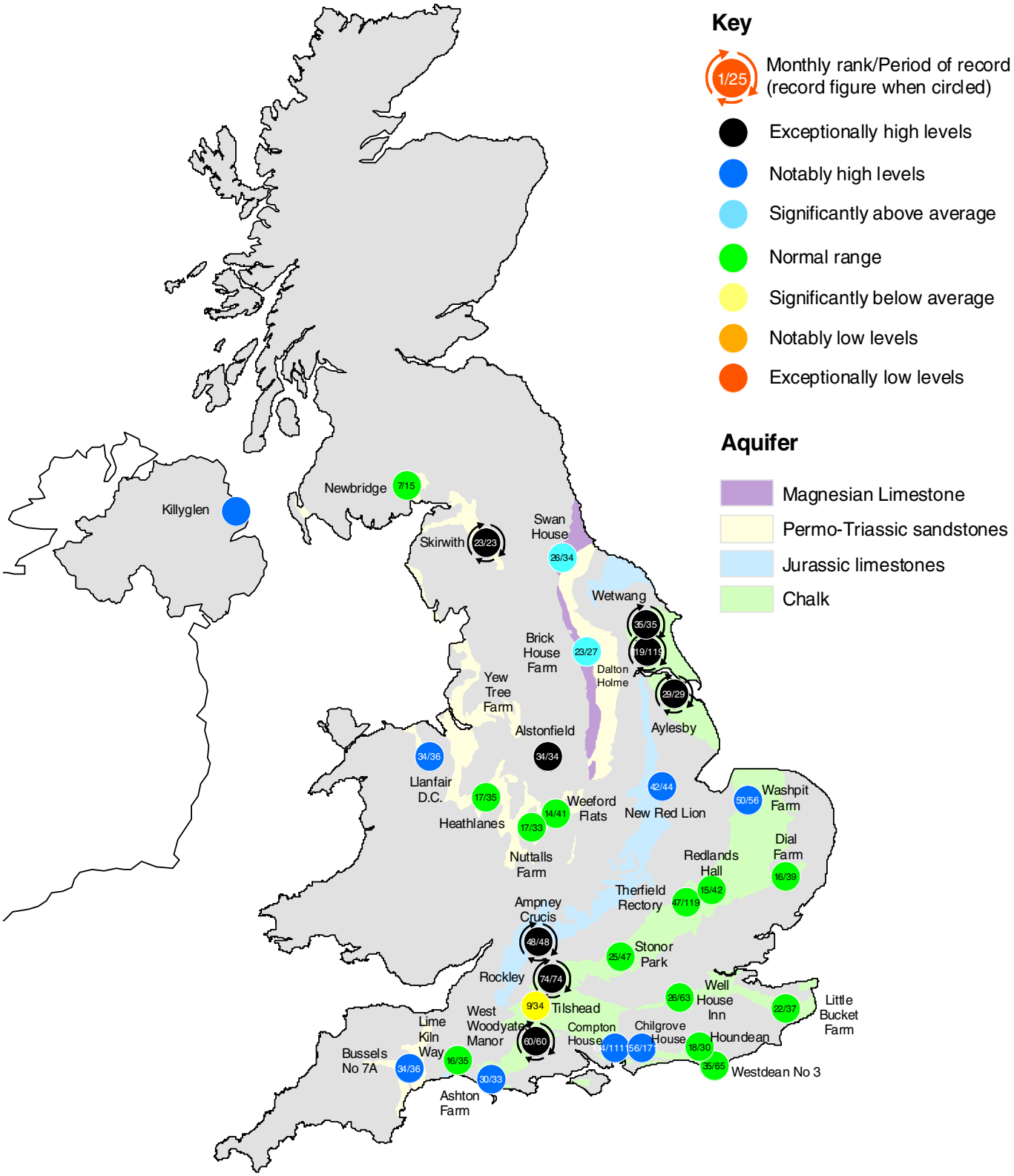


Groundwater levels August / September 2007

Borehole	Level	Date	Aug. av.	Borehole	Level	Date	Aug. av.	Borehole	Level	Date	Aug. av.
Dalton Holme	21.14	07/09	16.24	Chilgrove House	44.96	28/08	41.70	Brick House Farm	13.64	28/08	12.46
Washpit Farm	46.38	04/09	44.46	Killyglen	115.50	31/08	113.79	Llanfair DC	80.17	15/08	79.63
Stonor Park	77.59	03/09	75.76	New Red Lion	15.99	31/08	12.32	Heathlanes	62.10	31/08	62.10
Dial Farm	25.54	17/08	25.58	Ampney Crucis	101.62	03/09	100.16	Weeford Flats	89.55	01/08	89.82
Rockley	136.84	03/09	132.01	Newbridge	9.60	31/08	9.64	Bussels No.7a	23.88	08/08	23.58
Well House Inn	94.61	03/09	94.89	Skirwith	130.57	20/08	130.15	Alstonfield	184.92	03/09	177.41
West Woodyates	85.20	31/08	73.88	Swan House	84.21	16/08	83.01				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



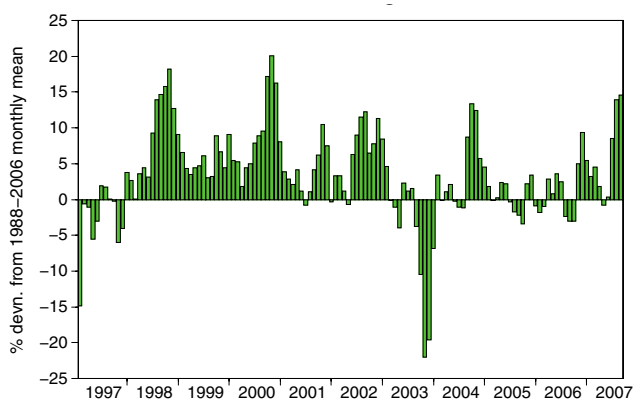
Groundwater levels - August 2007

The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and 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. Rankings may be omitted where they are considered misleading.

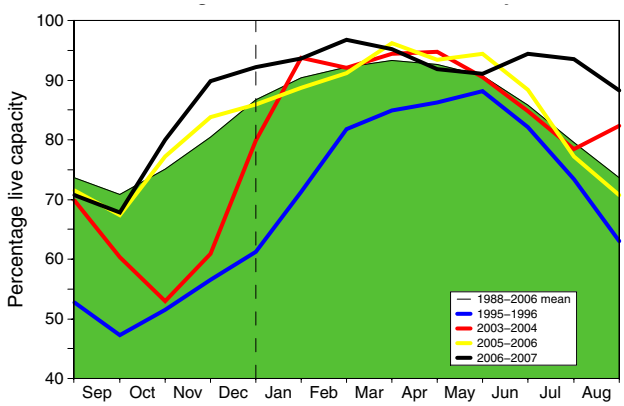
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

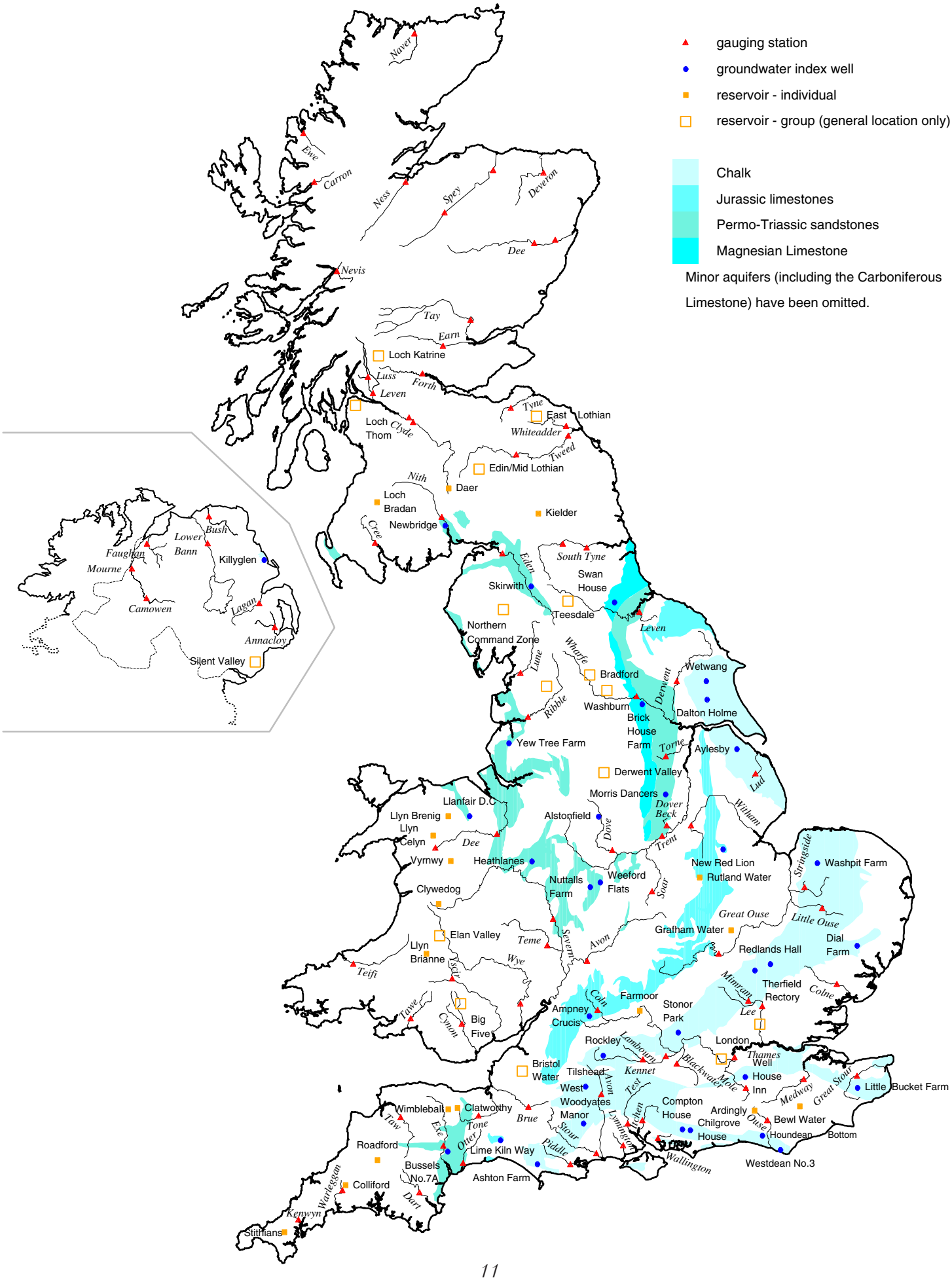
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2007 Jul	2007 Aug	2007 Sep	Sep Anom.	Min. Sep	Year* of min.	2006 Sep	Diff 07-06
North West	N Command Zone	• 124929	82	85	**77**	23	24	1995	57	23
	Vyrnwy	55146	94	96	**95**	26	36	1995	64	26
Northumbrian	Teesdale	• 87936	98	98	**87**	24	38	1995	65	24
	Kielder	(199175)	(96)	(94)	**(87)**	1	(66)	1989	(82)	1
Severn Trent	Clywedog	44922	100	100	**93**	19	38	1989	62	19
	Derwent Valley	• 39525	100	100	**90**	25	34	1995	66	25
Yorkshire	Washburn	• 22035	99	95	**87**	21	34	1995	77	21
	Bradford supply	• 41407	96	97	**92**	29	21	1995	69	29
Anglian	Grafham	(55490)	(97)	(94)	**(95)**	11	(59)	1997	(83)	11
	Rutland	(116580)	(97)	(94)	**(89)**	8	(66)	1995	(76)	8
Thames	London	• 202406	89	82	**77**	-1	62	1995	77	-1
	Farmoor	• 13822	97	94	**100**	8	64	1995	99	8
Southern	Bewl	28170	85	83	**79**	11	38	1990	68	11
	Ardingly	4685	100	100	**93**	22	47	1996	76	22
Wessex	Clatworthy	5364	78	100	**100**	40	31	1995	62	40
	Bristol WW	• (38666)	(98)	(96)	**(95)**	30	(43)	1990	(76)	30
South West	Colliford	28540	79	82	**83**	14	43	1997	46	14
	Roadford	34500	96	99	**95**	25	40	1995	55	25
	Wimbleball	21320	96	100	**98**	31	40	1995	71	31
	Stithians	5205	87	90	**83**	25	30	1990	47	25
Welsh	Celyn and Brenig	• 131155	99	100	**97**	18	49	1989	75	18
	Brianne	62140	97	100	**98**	14	55	1995	78	14
	Big Five	• 69762	96	98	**90**	24	29	1995	52	24
	Elan Valley	• 99106	100	99	**93**	19	46	1995	65	19
Scotland(E)	Edinburgh/Mid Lothian	• 97639	86	91	**88**	13	45	1998	77	13
	East Lothian	• 10206	100	100	**100**	19	63	1989	69	19
Scotland(W)	Loch Katrine	• 111363	72	70	**67**	-1	50	2000	63	-1
	Daer	22412	88	100	**96**	27	41	1995	63	27
	Loch Thom	• 11840	72	71	**72**	-6	58	1997	79	-6
Northern Ireland	Total+	• 67270	83	86	**89**	18	40	1995	68	18
	Silent Valley	• 20634	92	92	**97**	35	33	2000	66	35

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

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2006 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. 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



National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP) was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology Wallingford (formerly 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 for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the Department of the Environment (NI). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).
Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and the Northern Ireland Water Service.

The National River Flow Archive (maintained by CEH Wallingford) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Rainfall

Most rainfall data are provided by the Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of the Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS*. Recent figures have been produced by the Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national and regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available by the Met Office in 2004; these have been adopted by the NHMP. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.

NATURAL ENVIRONMENT RESEARCH COUNCIL

The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

*MORECS is the generic name for the Met Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100 Fax: 0870 900 5050
E-mail: enquiries@metoffice.com

The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

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Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

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E-mail: nwamail@ceh.ac.uk

Selected text and maps are available on the WWW at http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

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09/07