Hydrological Summary
for the United Kingdom

September 2007

General
Indian Summer conditions characterised the first half of September but, thereafter, weather patterns were much more autumnal. September rainfall totals were considerably below average across most of the country. Correspondingly, reservoirs stocks generally followed a normal seasonal decline – but from elevated late summer levels in southern Britain. Early October stocks in some large Scottish impoundments (e.g. Loch Thom) were significantly below average but mostly very healthy elsewhere. For England & Wales as a whole, stocks were the 4th highest in a 20-year series; reflecting abundant runoff in most gathering grounds over the last 12 months. September river flows were typical of the early autumn except in some spring-fed rivers where they remained close to seasonal maxima. The return to more normal soil moisture conditions in the early autumn saw groundwater level recessions re-established but levels in most index wells were considerably above the September average. The recent dry spell has moderated, but not eliminated, the enhanced risk of groundwater flooding in vulnerable parts of the Chalk outcrop this winter.

Rainfall
The high pressure, which dominated synoptic patterns during the first half of September, receded in mid-month allowing frontal systems to bring significant rainfall to some areas, mostly in the western uplands; Lusa (Skye) reported 46.4mm on the 15th and Capel Curig (N. Wales) 55.6mm on the 24th (a day when several tornadoes were reported in southern Britain, e.g. in Farnborough). Of greater hydrological significance was a notable dry spell which had extended beyond 30 days by mid-September. Some areas (e.g. in the Lower Severn basin) registered no measurable rainfall during this episode, and much of central England reported <5mm. This very settled interlude is reflected in the September rainfall totals. A few isolated localities (e.g. in the northern Pennines) exceeded the monthly average but parts of eastern Scotland registered their 4th driest September in 35 years. Many catchments in the English Lowlands reported less than half the monthly average rainfall – adding to a cluster of dry Septembers in England since the mid-1990s. As in August, particularly modest rainfall was reported for those areas worst afflicted by the summer flooding. After record May-July rainfall, the Severn-Trent Region registered its 2nd lowest Aug-Sept rainfall in 16 years. Nonetheless, rainfall totals – over timespans of 4-12 months remain well above average. The Oct-Sept period was the 2nd wettest since 1929/30 for England & Wales and unprecedented for Scotland in a 94-yr series.

River Flows
September runoff patterns exhibited substantial regional differences and a strong geological influence was evident, with clear contrasts between rivers draining impermeable catchments and those sustained principally by groundwater. In the former, some moderate spates were registered around the 24th (e.g. in northern England) but lengthy recessions were more typical. Entering October, flows in the responsive Annacloy (Northern Ireland) had fallen close to the monthly minimum. By contrast, in some spring-fed rivers (including the Coln and Lambourn) flows – although in recession – established new runoff maxima for September. Such rivers aside, September runoff was generally well within the normal range, albeit low in some sheltered eastern catchments in Scotland and Northern Ireland. The exceptional summer runoff is clearly reflected in runoff accumulations for the May-Sept period. Many new period-of-record maxima were established in a broad zone from the North-East to Devon; previous maxima for the Gt Ouse and Warwickshire Avon were eclipsed by considerable margins in records of >70 years. The widespread extension in the range of recorded summer flows is well illustrated by the River Coln (in the Cotswolds) where flows remained above previous daily maxima for three months until the end of September. Longer term runoff totals remain outstanding in much of Scotland where new water-year (Oct-Sept) runoff maxima were established from the Naver to the Nith.

Groundwater
Soil moisture deficits, which had largely been eliminated by the summer rainfall, were re-established through September and, by early October, were within the normal range across most aquifer outcrop areas. Soil conditions are thus exercising a normal seasonal constraint on aquifer recharge. Correspondingly, infiltration in September was minimal and groundwater levels recessions have become re-established except in the slowest responding aquifer units. Nonetheless, September groundwater levels were generally above average; notably so in many outcrops of the Jurassic Limestone (where September levels were still rising at the confined New Red Lion well), and in the western and northern extremities of the Chalk. In the latter, despite recent recessions, new September maximum levels were established at Aylesby and Rockley (in a series from 1933). Levels were also seasonally very high at Wash Pit Farm in Norfolk. Levels are still increasing in many of the slow responding Permo-Triassic outcrops in the Midlands; a particularly brisk recovery has been registered at Nuttalls Farm since the early summer. Spatial variations in soil moisture conditions are considerable but, in most outcrop areas, deficits are the equivalent of 6-10 weeks autumn rainfall. It is likely therefore that the winter recharge season will commence with groundwater levels above the seasonal norm and, in the event of a wet winter, maximum groundwater levels could be notably high, particularly in parts of the Chalk.

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

Rainfall accumulations and return period estimates

Area *psep 07	Rainfall	Sep 2007	Aug 07-Sep 07	RP	May 07-Sep 07	RP	Jan 07-Sep 07	RP	Oct 06-Sls -Irt	RP
England & Wales	**mm**	**52**	**112**		**508**		**794**		**1152**	
	%	**67**	**72**	**5-10**	**147**	**50-80**	**126**	**15-25**	**127**	**30-45**
North West	mm	**99**	182		626		993		1519	
	%	**85**	80	2-5	133	10-20	118	5-10	125	20-30
Northumbrian	mm	**57**	109		465		707		1002	
	%	**77**	69	5-10	134	10-20	114	5-10	116	5-10
Severn Trent	mm	**40**	80		504		749		1026	
	%	**62**	60	5-10	163	>100	136	30-50	134	50-80
Yorkshire	mm	**47**	91		496		741		1023	
	%	**67**	62	5-10	150	40-60	124	10-20	123	10-20
Anglian	mm	**33**	86		412		578		764	
	%	**65**	81	2-5	161	>100	132	20-35	126	20-30
Thames	mm	**29**	80		416		637		919	
	%	**49**	67	5-10	149	30-40	127	10-20	131	20-35
Southern	mm	**34**	85		395		638		963	
	%	**48**	67	5-10	139	10-20	119	5-10	123	10-20
Wessex	mm	**35**	87		458		738		1104	
	%	**48**	62	5-10	146	20-35	124	5-15	129	20-30
South West	mm	**50**	138		566		1013		1493	
	%	**54**	77	2-5	143	20-30	126	10-20	125	15-25
Welsh	mm	**88**	169		678		1130		1742	
	%	**75**	76	2-5	144	30-45	125	10-20	129	30-45
Scotland	**mm**	**98**	**244**		**619**		**1185**		**1884**	
	%	**68**	**93**	**2-5**	**117**	**5-10**	**119**	**10-20**	**128**	**>100**
Highland	mm	**137**	321		710		1444		2322	
	%	**81**	108	2-5	119	5-10	125	20-35	133	>100
North East	mm	**66**	172		541		860		1260	
	%	**71**	94	2-5	135	20-30	119	5-15	122	20-30
Tay	mm	**48**	165		576		1074		1712	
	%	**39**	75	2-5	124	5-10	120	5-15	133	70-100
Forth	mm	**55**	174		519		959		1525	
	%	**48**	83	2-5	119	5-10	120	10-20	133	>100
Tweed	mm	**58**	140		509		819		1224	
	%	**63**	77	2-5	128	5-15	115	5-10	122	15-25
Solway	mm	**82**	206		612		1088		1759	
	%	**57**	78	2-5	115	2-5	111	2-5	122	20-30
Clyde	mm	**114**	267		646		1324		2182	
	%	**62**	82	2-5	102	2-5	112	5-10	125	30-45
Northern Ireland	**mm**	**58**	**157**		**507**		**832**		**1227**	
	%	**58**	**80**	**2-5**	**123**	**5-10**	**109**	**2-5**	**112**	**5-10**

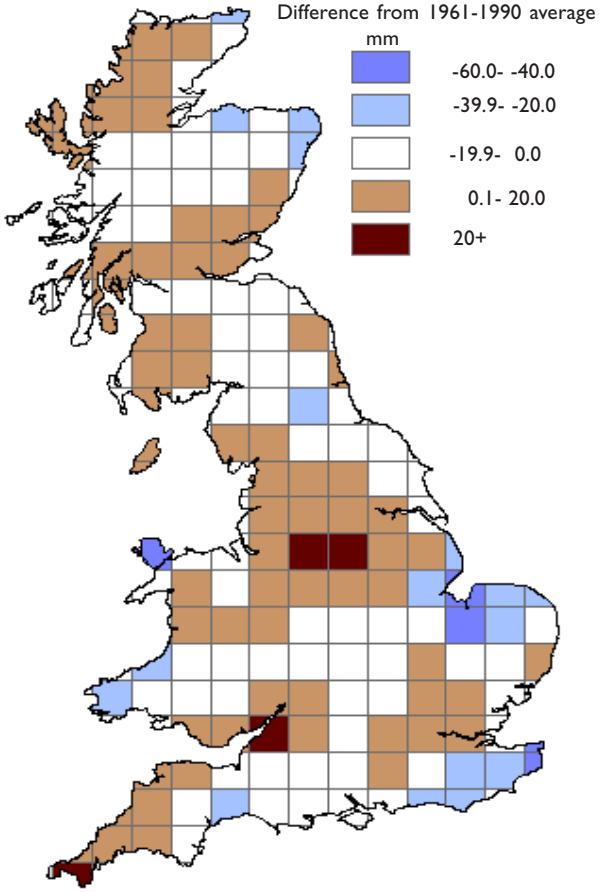
% = percentage of 1961-90 average *RP = Return period*

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.

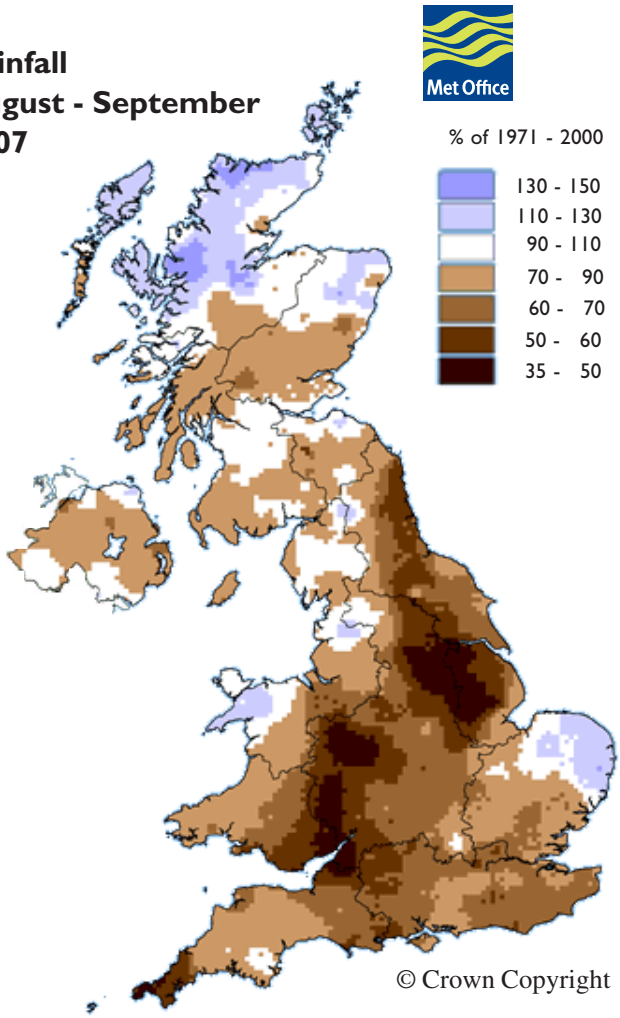
All monthly rainfall totals since May 2007 are provisional.

Rainfall . . . Rainfall . . .

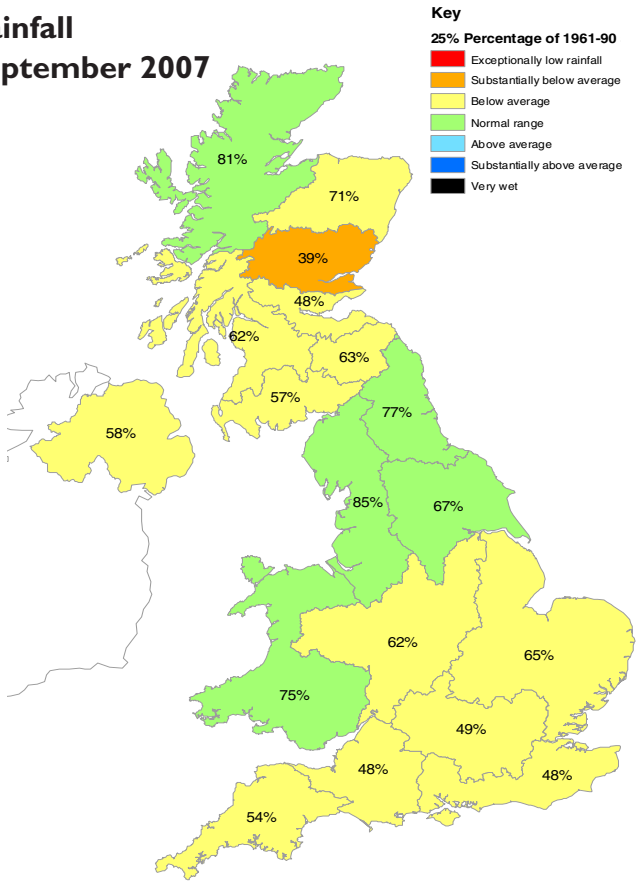
Soil Moisture Deficit
September 2007



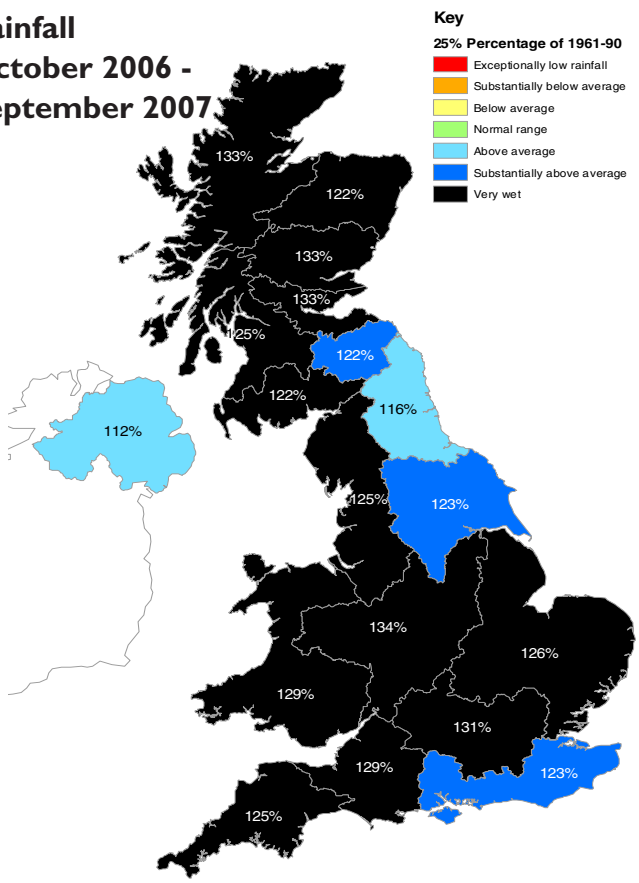
Rainfall
August - September 2007



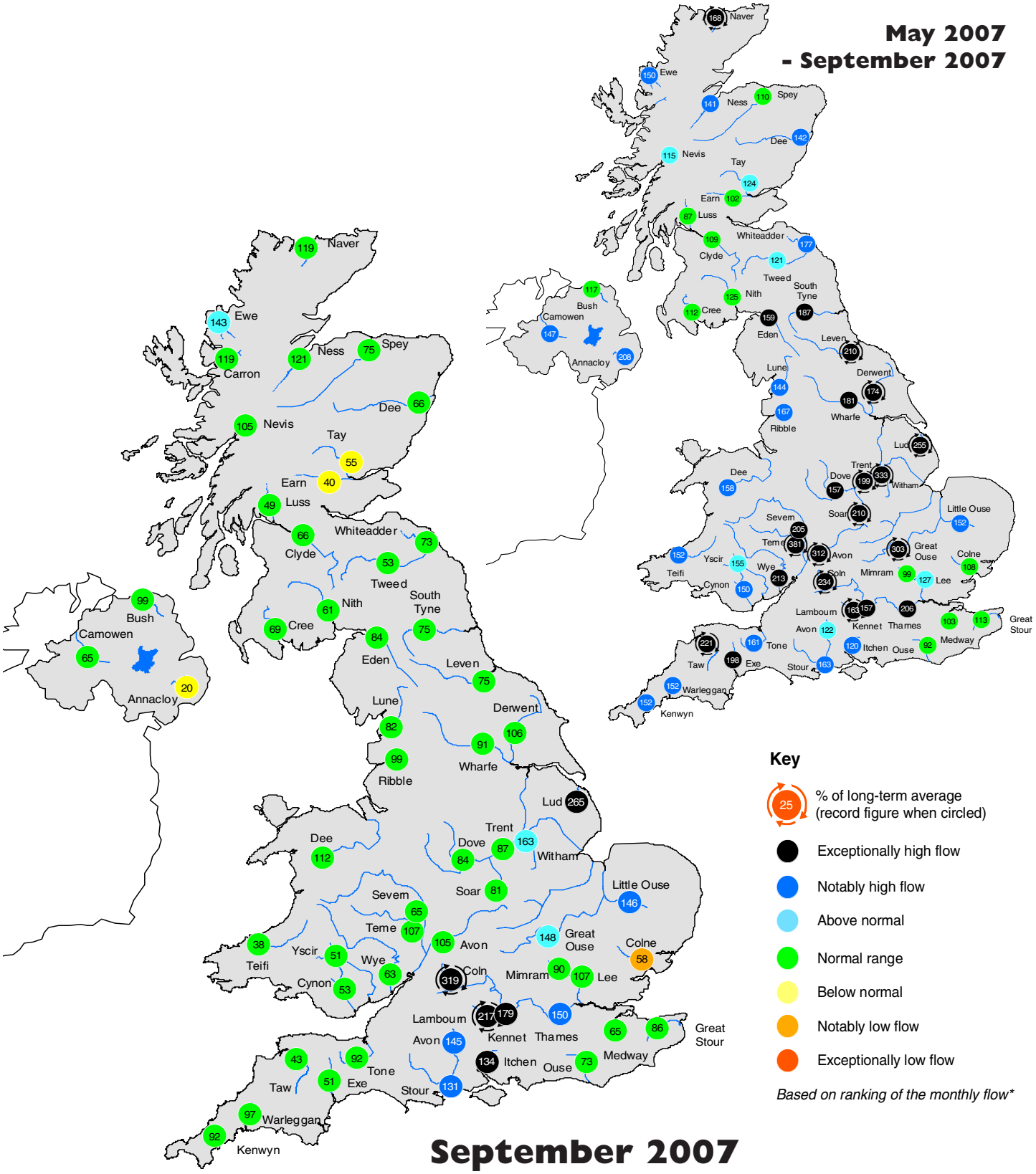
Rainfall
September 2007



Rainfall
October 2006 - September 2007



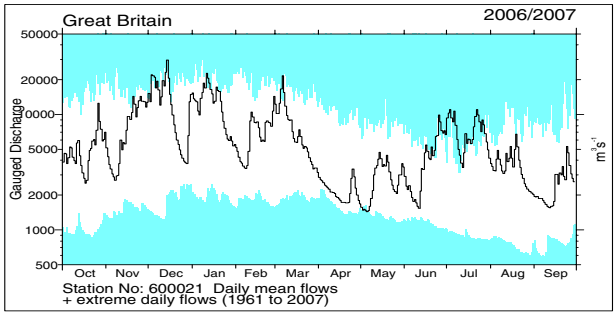
River flow . . . River flow . . .

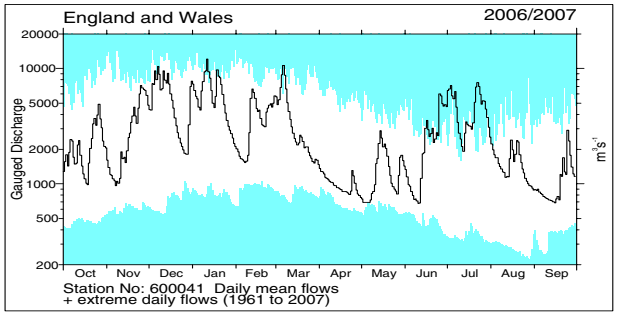


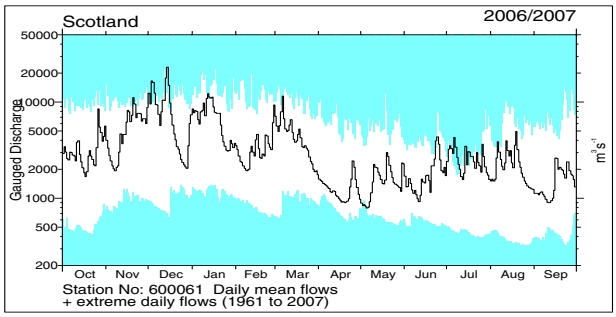
River flows

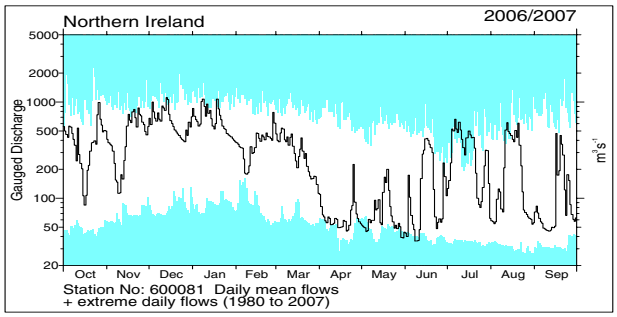
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

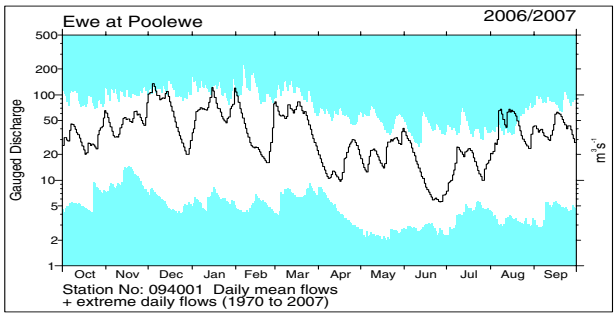
River flow . . . River flow . . .

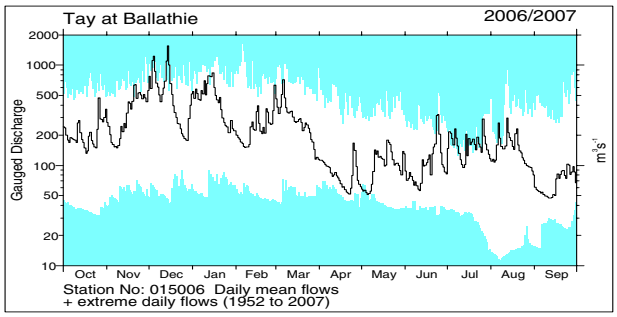


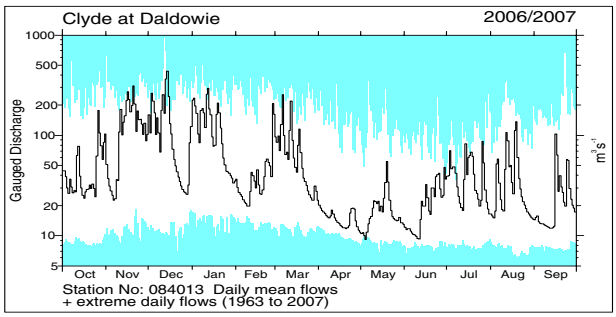


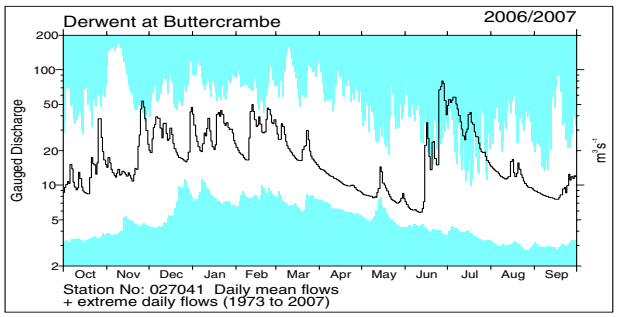


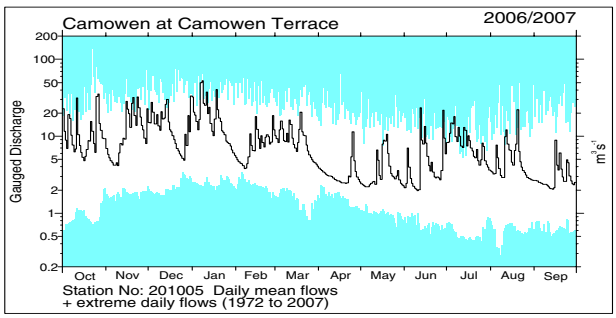


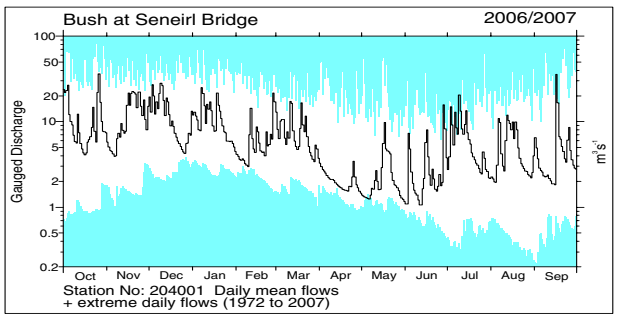








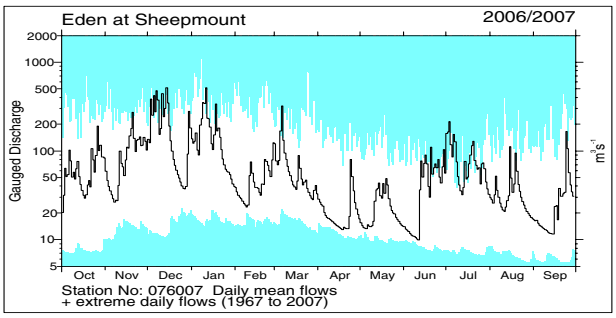


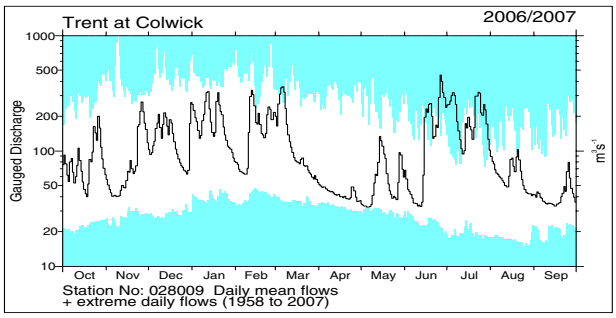


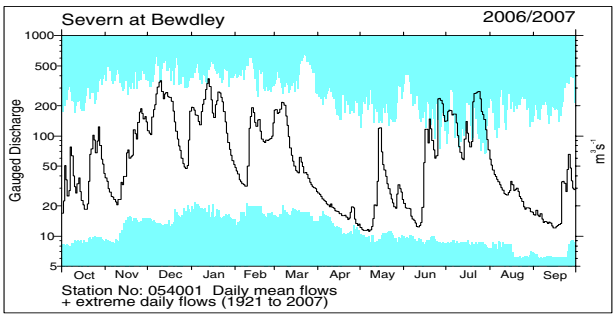
River flow hydrographs

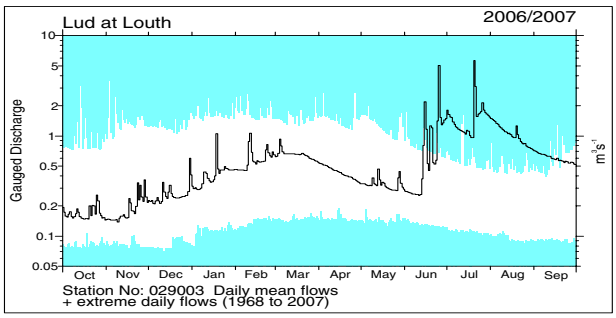
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to October 2006 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

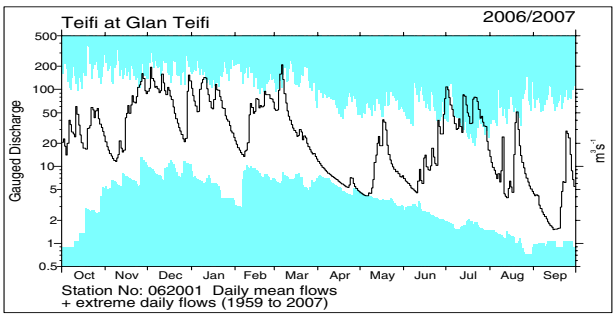
River flow . . . River flow . . .

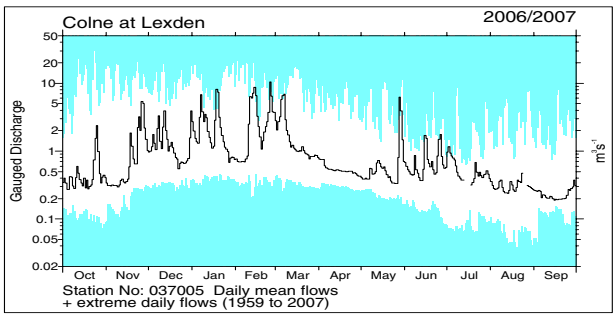


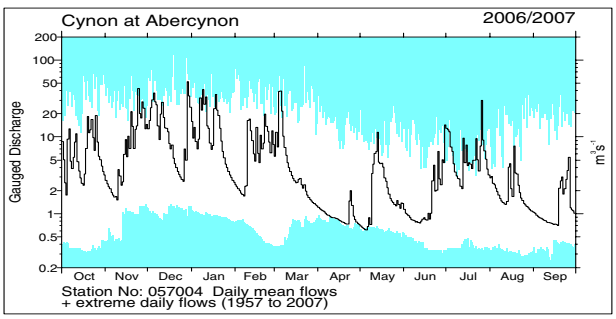


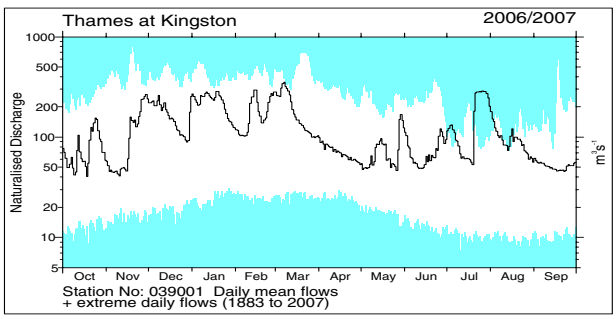


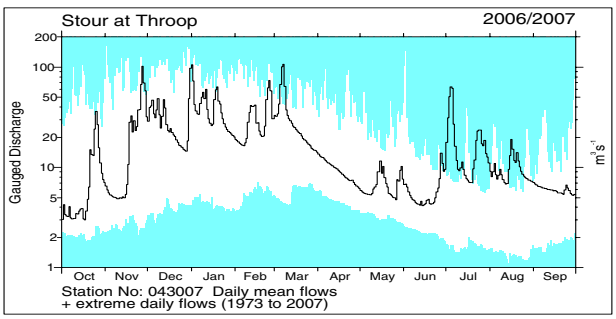


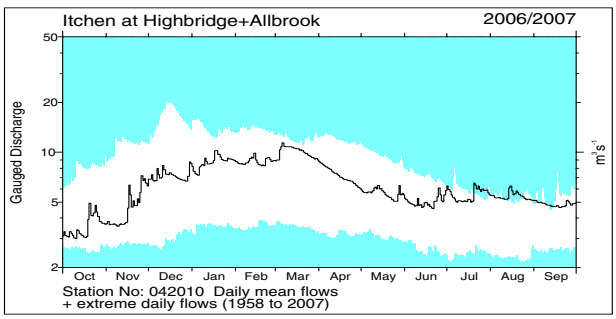












Notable runoff accumulations (a) Aug 2007 - Sep 2007, (b) May 2007 - Sep 2007, (c) Oct 2006 - Sep 2007

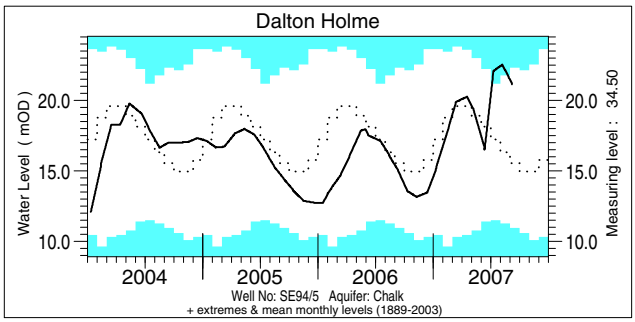
	River	%lta	Rank
a)	Dover Beck	214	31/32
	Lud	323	40/40
	Stringside	350	42/42
	Thames (nat)	218	122/125
	Kennet	191	46/46
	Lambourn	221	45/45
	Coln	381	44/44
	Itchen	139	49/49
	Avon (Amesbury)	156	43/43
	Ewe	181	36/37

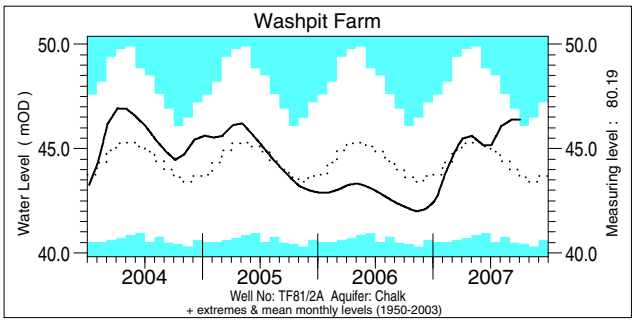
	River	%lta	Rank
b)	Leven (Leven Br)	210	47/47
	Trent	199	49/49
	Ouse (Bedford)	303	75/75
	Blackwater	158	54/55
	Taw	221	49/49
	Avon (Evesham)	312	71/71
	Annacloy	208	26/28

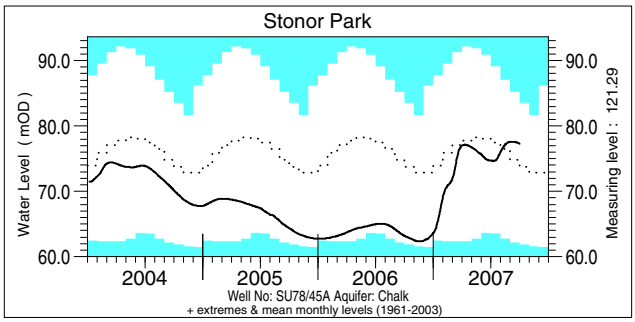
	River	%lta	Rank
c)	Earn	135	59/59
	Tweed (Boleside)	125	46/46
	Dart	144	49/49
	Dee (Manley Hall)	137	70/70
	Eden	139	40/40
	Nith	132	50/50
	Naver	151	30/30

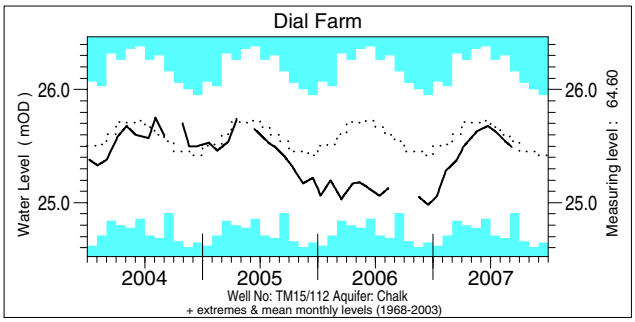
lta = long term average
Rank 1 = lowest on record

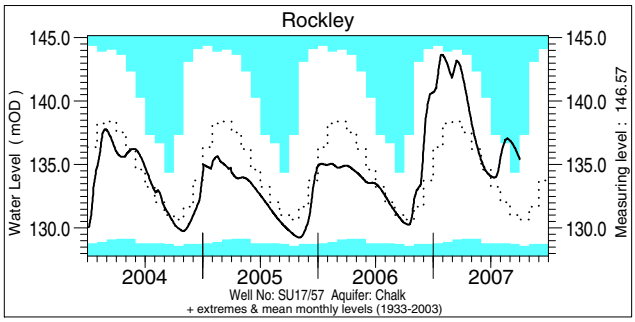
Groundwater . . . Groundwater

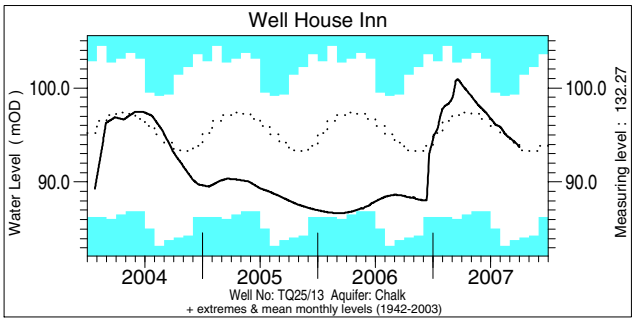


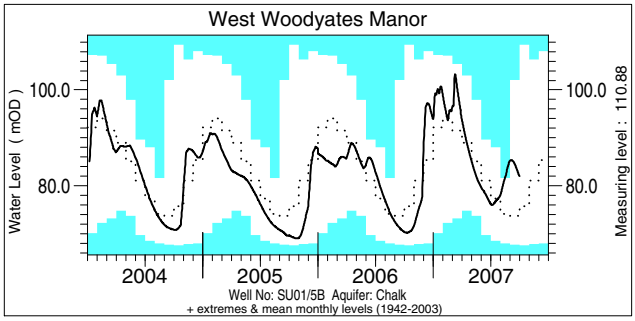


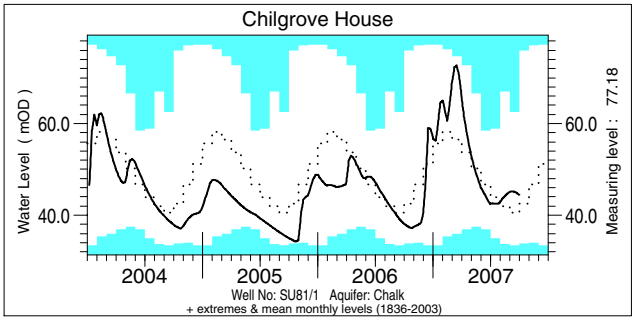


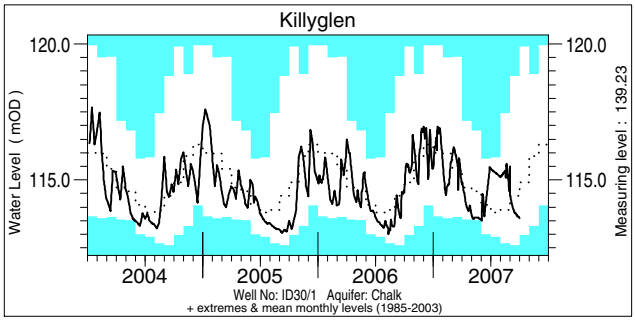


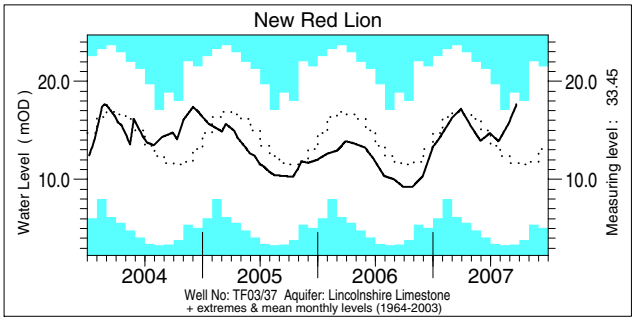






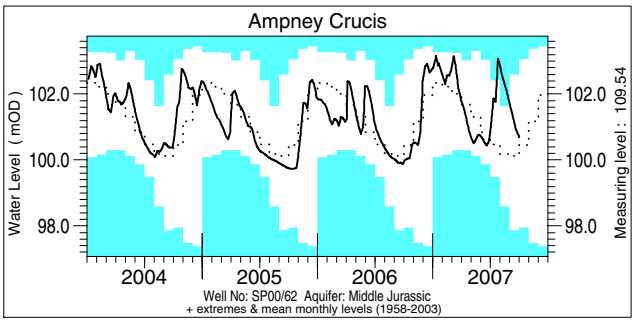


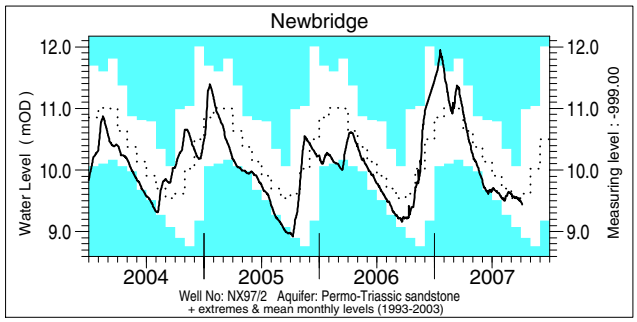


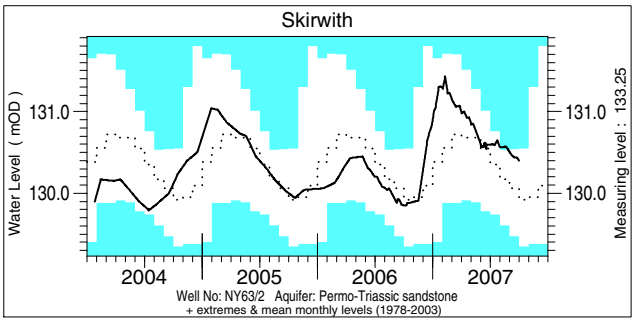


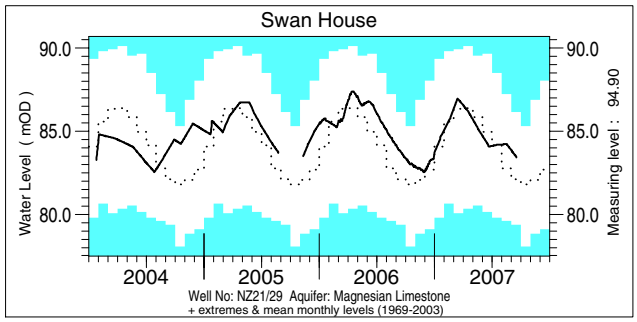
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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.

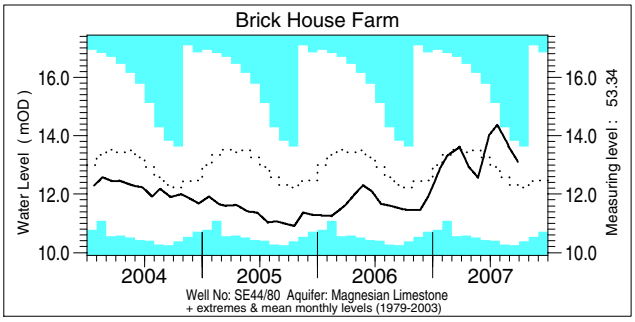
Groundwater . . . Groundwater

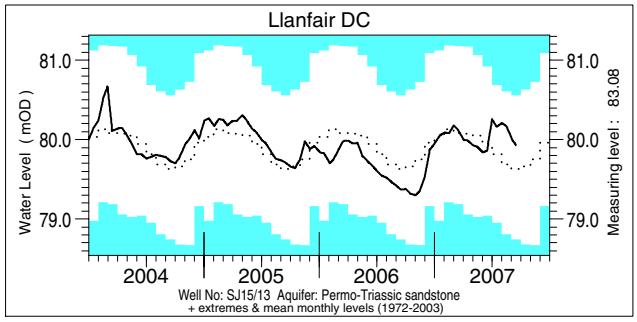


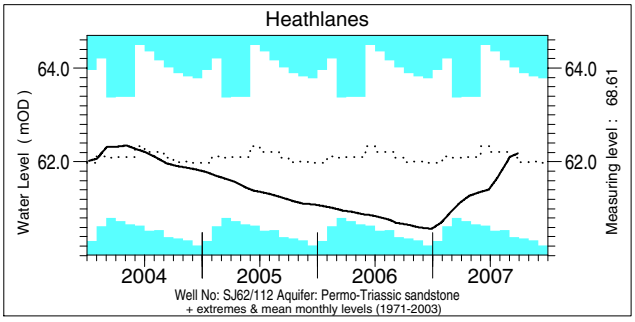


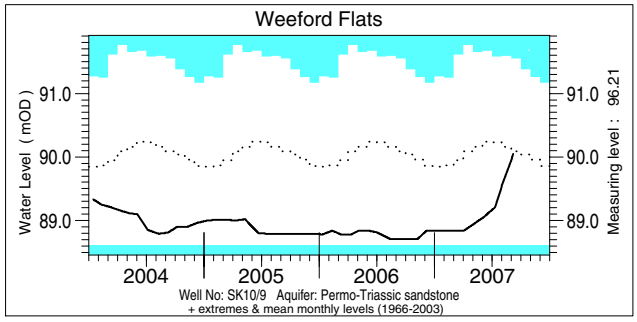


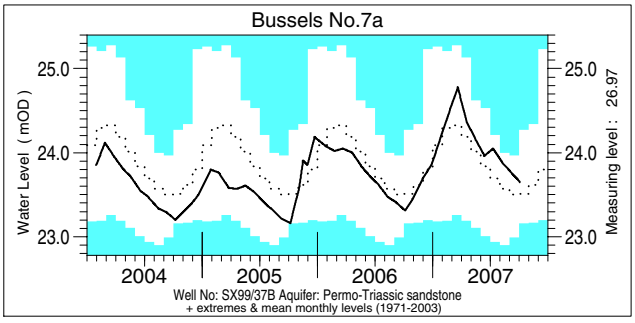


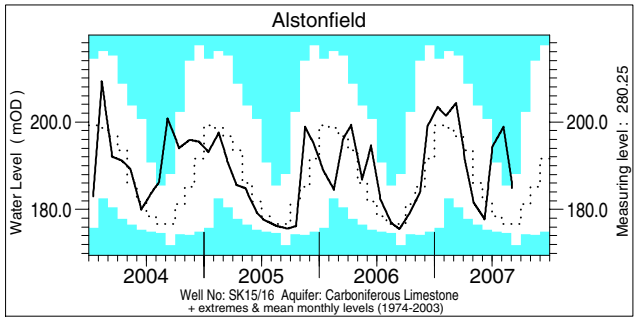








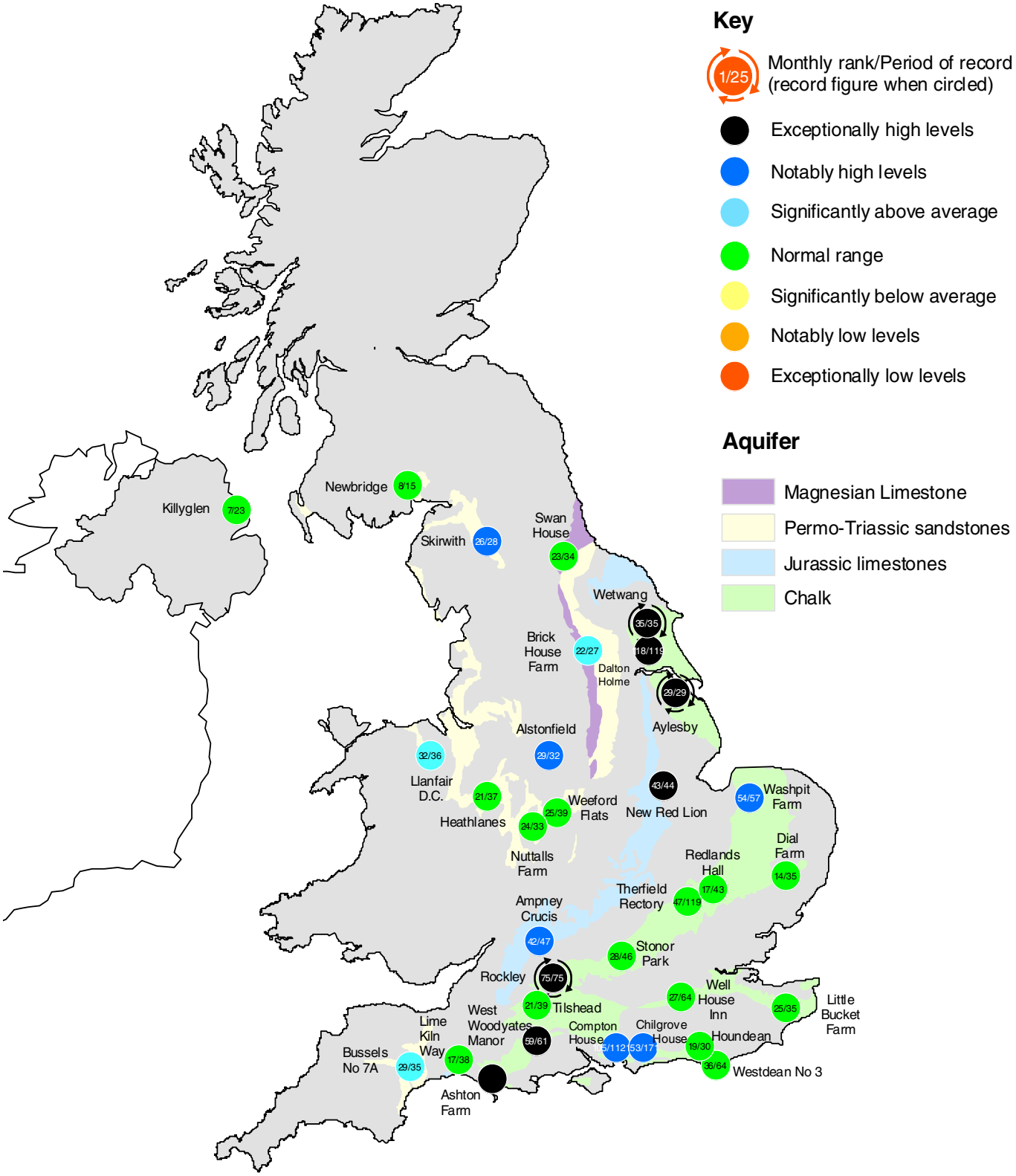




Groundwater levels September / October 2007

Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.
Dalton Holme	21.14	07/09	15.42	Chilgrove House	44.46	30/09	40.73	Brick House Farm	13.11	26/09	12.23
Washpit Farm	46.40	02/10	43.98	Killyglen	113.59	30/09	114.33	Llanfair DC	79.93	15/09	79.55
Stonor Park	77.27	01/10	74.37	New Red Lion	17.64	21/09	11.60	Heathlanes	62.18	26/09	62.00
Dial Farm	25.49	07/09	25.55	Ampney Crucis	100.69	01/10	100.07	Weeford Flats	90.05	06/09	89.78
Rockley	135.41	01/10	131.00	Newbridge	9.44	05/10	9.51	Bussels No.7a	23.65	03/10	23.50
Well House Inn	93.68	01/10	94.00	Skirwith	130.40	30/09	130.07	Alstonfield	184.92	03/09	177.43
West Woodyates	81.96	30/09	72.88	Swan House	83.41	17/09	82.38	*Levels in metres above Ordnance Datum*			

Groundwater . . .Groundwater



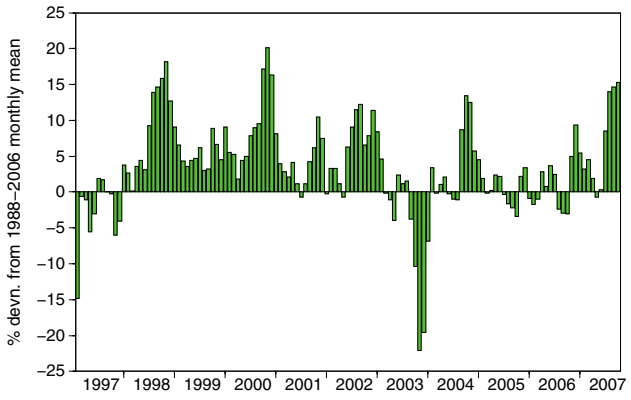
Groundwater levels - September 2007

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.

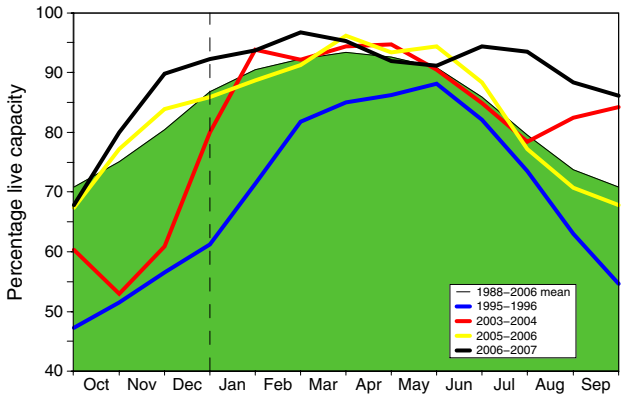
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

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.

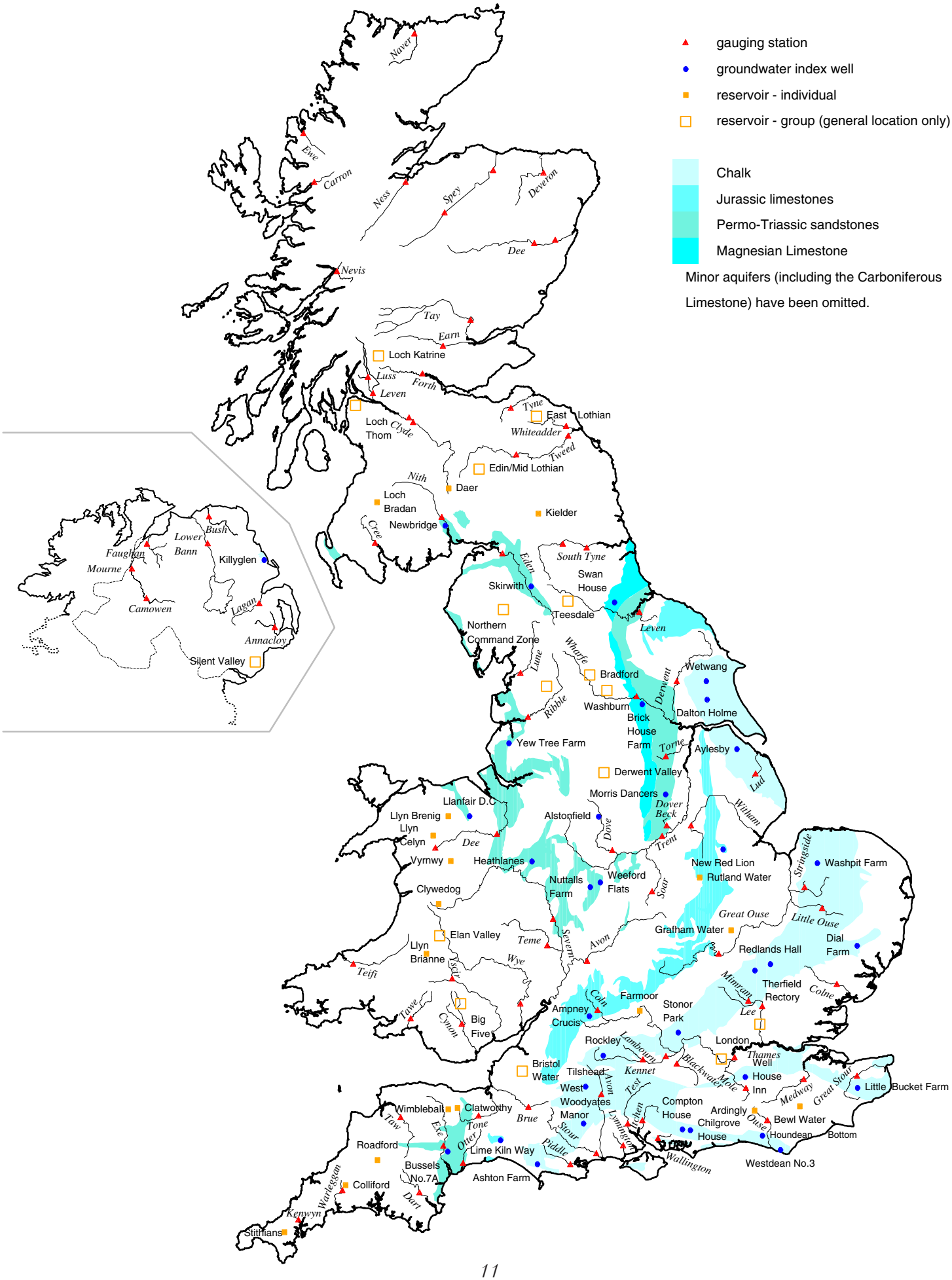
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2007 Aug	Sep	Oct	Oct Anom.	Min. Oct	Year* of min.	2006 Oct	Diff **07-06**
North West	N Command Zone	• 124929	85	77	**72**	20	13	1995	58	14
	Vyrnwy	55146	96	95	**90**	24	26	1995	59	31
Northumbrian	Teesdale	• 87936	98	87	**88**	26	31	1995	62	26
	Kielder	(199175)	(94)	(87)	**(82)**	-2	(59)	1989	(83)	-1
Severn Trent	Clywedog	44922	100	93	**88**	21	24	1989	51	37
	Derwent Valley	• 39525	100	90	**86**	25	24	1989	70	16
Yorkshire	Washburn	• 22035	95	87	**81**	19	24	1995	77	4
	Bradford supply	• 41407	97	92	**87**	24	15	1995	65	22
Anglian	Grafham	(55490)	(94)	(95)	**(93)**	12	(46)	1997	(80)	13
	Rutland	(116580)	(94)	(89)	**(86)**	8	(61)	1995	(71)	15
Thames	London	• 202406	82	77	**84**	10	53	1997	75	9
	Farmoor	• 13822	94	100	**93**	4	54	2003	98	-5
Southern	Bewl	28170	83	79	**72**	9	32	1990	61	11
	Ardingly	4685	100	93	**81**	17	32	2003	66	15
Wessex	Clatworthy	5364	100	100	**88**	36	25	2003	49	39
	Bristol WW	• (38666)	(96)	(95)	**(87)**	28	(31)	1990	(69)	18
South West	Colliford	28540	82	83	**80**	15	38	2006	38	42
	Roadford	34500	99	95	**91**	24	26	1995	47	44
	Wimbleball	21320	100	98	**91**	30	30	1995	60	31
	Stithians	5205	90	83	**73**	21	22	1990	36	37
Welsh	Celyn and Brenig	• 131155	100	97	**96**	19	39	1989	76	20
	Brianne	62140	100	98	**98**	16	48	1995	77	21
	Big Five	• 69762	98	90	**82**	20	19	1995	44	38
	Elan Valley	• 99106	99	93	**94**	21	34	1995	58	36
Scotland(E)	Edinburgh/Mid Lothian	• 97639	91	88	**84**	9	43	1998	79	5
	East Lothian	• 10206	100	100	**100**	23	52	1989	66	34
Scotland(W)	Loch Katrine	• 111363	70	67	**61**	-11	43	1995	77	-16
	Daer	22412	100	96	**88**	17	32	1995	86	2
	Loch Thom	• 11840	71	72	**68**	-11	56	1995	94	-26
Northern Ireland	Total+	• 67270	86	89	**78**	9	29	1995	76	2
	Silent Valley	• 20634	92	97	**82**	21	27	1995	72	10

() 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

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*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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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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10/07