Hydrological Summary
for the United Kingdom

June 2006

General

June was a notably warm and, in most regions, a very dry month – with heatwave conditions contributing to a dramatic change in the complexion of the landscape in much of the drought-affected region. England and Wales registered its 2nd lowest June rainfall in 30 years and evaporation demands were exceptionally high. Correspondingly, reservoir stocks declined appreciably (e.g. in Wales) but overall stocks for England &Wales remain above the early summer average and most reservoirs reported higher levels than in early July 2005. However, brisk declines are anticipated in some drought-affected areas (e.g. parts of the South-East) as surface water sources are preferentially exploited to help protect depleted groundwater storage. Some significant spates occurred in western Scotland, and thunderstorms generated very localised flooding but, generally, June saw sustained river flow recessions – contributing to depressed long term runoff accumulations over wide areas. Overall groundwater storage is healthier than in the summers of 1992 or 1997 but resources are very depleted in parts of the Midlands and South East. Exceptional increases in soil moisture deficits through June emphasise the vulnerability of such areas to a dry late summer and early autumn. The resulting delay in the seasonal recovery in aquifer recharge would make for a very fragile water resources outlook, in parts of the South East especially.

Rainfall

With high pressure extending west from the continent, rain-bearing frontal systems were very uncommon in June, exceptionally so in parts of eastern Britain. Some notable storm events were recorded, e.g. in western Scotland, Cluanie Dam reported 145mm in 48 hrs (20/21st) and, to the south, thunderstorms triggered flash floods. But lengthy sequences of dry days were more typical; a number of localities (e.g. in Yorkshire, Kent and South Oxon) registered only around 5mm of rain in June (the lowest June total since 1962 in some areas). Above average June rainfall was largely restricted to western Scotland and the Hebrides. Most of E&W reported less than half the monthly average with totals below 20% in a broad zone from North Yorkshire to the M4. For E&W, it was the 2nd driest month in the last seven years and the 2nd driest June since 1976. The current drought conditions are more fully characterised by longer term rainfall deficiencies. The South-West reported its 2nd driest Jan-June in 30 years and regional deficiencies in the 20-month timeframe remain large across much of England. For the Thames region, accumulated rainfall since Oct. 2004 is the lowest for over 60 years (with the greater part of the deficiency attributable to the winter/spring periods). The regional dimension to the drought is overlain with significant local variations in intensity; overall rainfall deficiencies range from <15 to >30% of average. Two zones of maximum intensity may be identified: Dorset/Isle of Wight trending NE to Cambs, and East Sussex to South London; Cornwall has been exceptionally dry also.

River Flows

A number of notably high summer flows were recorded, in western and northern Scotland especially, during the 3rd week of June; on the 21st the River Ewe registered its highest June flow since 1973. Convective storms triggered some locally disruptive flash floods (e.g. Harlow on the 14th, East London on the 19th) but, generally, river flow recessions were steep and sustained. June runoff totals for most westward-draining rivers in the Scottish Highlands were well above normal but totals in most index rivers were substantially below average – exceptionally so in some southern spring-fed catchments (eg. in the Chilterns and Isle of Wight. More revealing in drought severity terms were the end of month flows (depressed over wide areas) and long term accumulations. The Mimram, Lambourn and Test (all Chalk rivers with >40 year records) each registered their 2nd lowest July-June runoff on record (as did the Cree in Scotland); in South London, the Ravensbourne reported its lowest July-June runoff in a 30-year record. In the 20-month timespan a significant proportion of eastern and southern rivers rank among the lowest three on record with unprecedented accumulated runoffs for the Medway and Sussex Ouse. Flow augmentation is being undertaken in a number of drought-affected rivers (e.g. in Dorset) and a hot, dry summer would increase water quality and ecological stress as low flows decline further.

Groundwater

June rainfall totals over most major aquifers were <40% of average – and below 10% in a few outcrop areas. With actual evaporation totals well above average, soil moisture deficits climbed very rapidly, in the English Lowlands especially. As a consequence, the recharge season was decisively, if belatedly, terminated. Some residual groundwater level increases followed the modest May infiltration (e.g. in Kent, and more notably at Alstonfield in the Carboniferous Limestone) but except in the slowest-responding wells, levels are now in seasonal recession. June levels were mostly above those of last year and, at the national scale, groundwater resources are significantly healthier than during the summers of 1997 or 1992 (when overall Chalk resources were probably more depleted than for >85 years). Nonetheless, current levels remain very depressed in many Permo-Triassic sandstones outcrops in the Midlands – at Morris Dancers levels are closely comparable with the lowest June level in a 37-yr series. Severely depressed levels also characterise parts of the southern Chalk, especially in the Chilterns and parts of North Downs, where at Well House Inn levels were the lowest for June since 1944. With above average smds in almost all major outcrop areas, groundwater levels are expected to decline well into the autumn. A notably dry late summer/early autumn (as in 2003) would result in very extended recessions, and restrict the length of the 2006/07 season – a matter of considerable concern in the drought-affected region.

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

Rainfall accumulations and return period estimates

Area	Rainfall	June 2006	Apr 06- Jun 06	*RP*	Jan 06- Jun 06	*RP*	Jul 05- Jun 06	*RP*	Nov 04- Jun 06	*RP*
England	**mm**	**25**	**183**		**359**		**834**		**1304**	
& Wales	%	**39**	**98**	**2-5**	**87**	**2-5**	**92**	**2-5**	**87**	**5-15**
North West	mm	**43**	236		502		1117		1842	
	%	**53**	103	2-5	96	2-5	92	2-5	92	2-5
Northumbrian	mm	**27**	155		352		837		1371	
	%	**43**	85	2-5	89	2-5	97	2-5	96	2-5
Severn Trent	mm	**17**	162		290		702		1079	
	%	**28**	92	2-5	80	5-10	91	2-5	84	10-20
Yorkshire	mm	**17**	178		365		792		1231	
	%	**27**	98	2-5	94	2-5	95	2-5	89	5-10
Anglian	mm	**16**	148		244		555		851	
	%	**30**	100	<2	86	2-5	92	2-5	85	5-15
Thames	mm	**15**	151		271		603		907	
	%	**28**	93	2-5	82	2-5	86	5-10	78	30-40
Southern	mm	**21**	156		299		691		1017	
	%	**39**	97	2-5	83	2-5	88	2-5	77	30-40
Wessex	mm	**33**	169		313		755		1190	
	%	**58**	98	2-5	78	5-10	88	2-5	83	10-20
South West	mm	**38**	180		411		1036		1660	
	%	**55**	84	2-5	74	5-15	87	5-10	82	10-20
Welsh	mm	**34**	266		558		1307		2027	
	%	**42**	107	2-5	93	2-5	97	2-5	90	5-10
Scotland	**mm**	**72**	**300**		**619**		**1397**		**2514**	
	%	**84**	**119**	**5-10**	**96**	**2-5**	**95**	**2-5**	**104**	**2-5**
Highland	mm	**90**	401		758		1732		3213	
	%	**91**	140	20-30	101	2-5	100	<2	111	5-15
North East	mm	**46**	173		375		924		1627	
	%	**67**	82	2-5	81	5-10	90	2-5	96	2-5
Tay	mm	**63**	230		538		1170		2087	
	%	**83**	100	<2	91	2-5	91	2-5	98	2-5
Forth	mm	**45**	201		450		1012		1862	
	%	**62**	96	2-5	88	2-5	88	5-10	99	2-5
Tweed	mm	**32**	161		382		910		1540	
	%	**48**	80	2-5	84	5-10	91	2-5	93	2-5
Solway	mm	**73**	273		637		1337		2282	
	%	**86**	109	2-5	102	2-5	93	2-5	97	2-5
Clyde	mm	**89**	360		742		1609		2914	
	%	**92**	128	5-10	100	<2	92	2-5	102	2-5
Northern	**mm**	**39**	**222**		**458**		**1007**		**1697**	
Ireland	%	**53**	**105**	**2-5**	**91**	**2-5**	**92**	**2-5**	**93**	**2-5**

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

The monthly rainfall figures* provided by the Met Office (National Climate Information Centre) are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation. **All monthly totals since January 2006 are provisional (see page 12).** 1961-2003 regional monthly totals were revised by the Met Office in 2004. Most of the return period estimates are based on tables provided by the Met 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); RP estimates for Northern Ireland are based on the tables for north-west England. The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts, in the Scottish rainfall series in particular, can exaggerate the relative wetness of the recent past. *See page 12.

Rainfall . . . Rainfall . . .

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

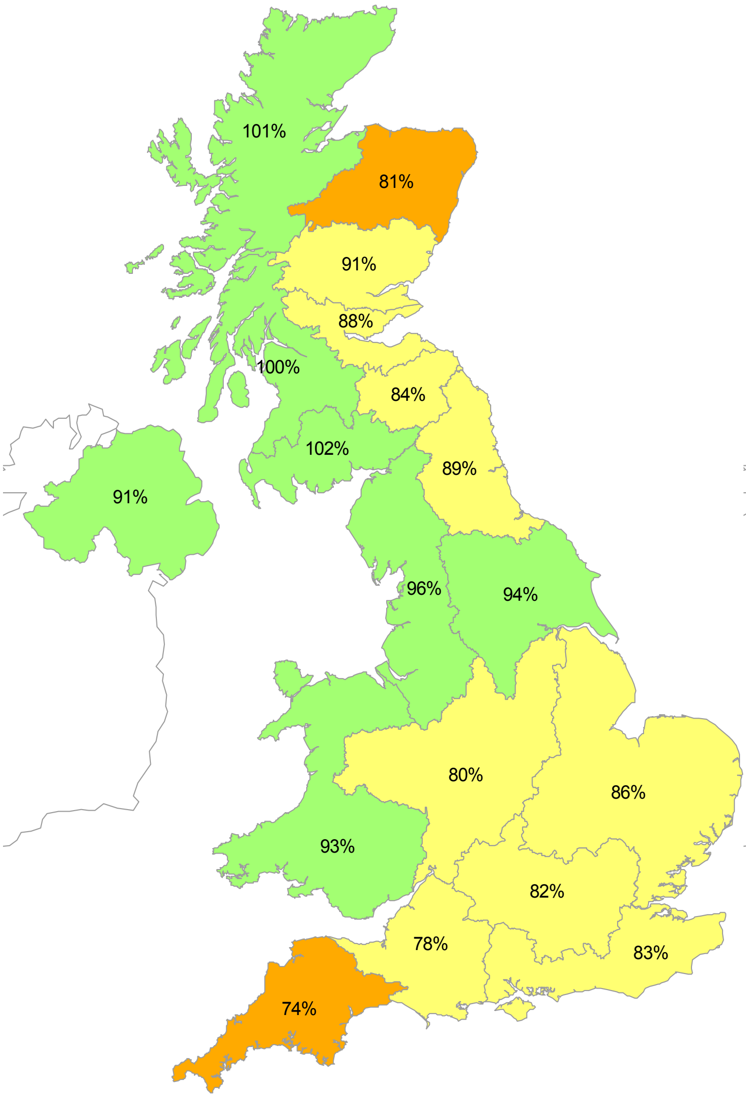
Above average

Normal range

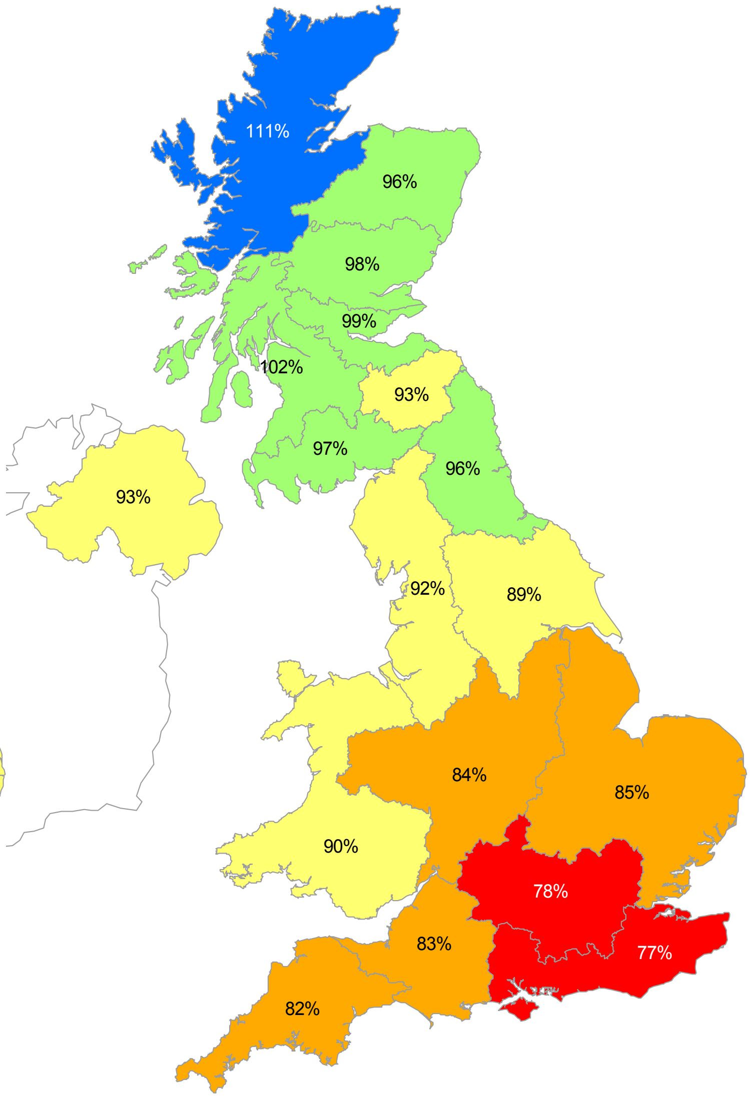
Below average

Substantially below average

Exceptionally low rainfall



January 2006 - June 2006

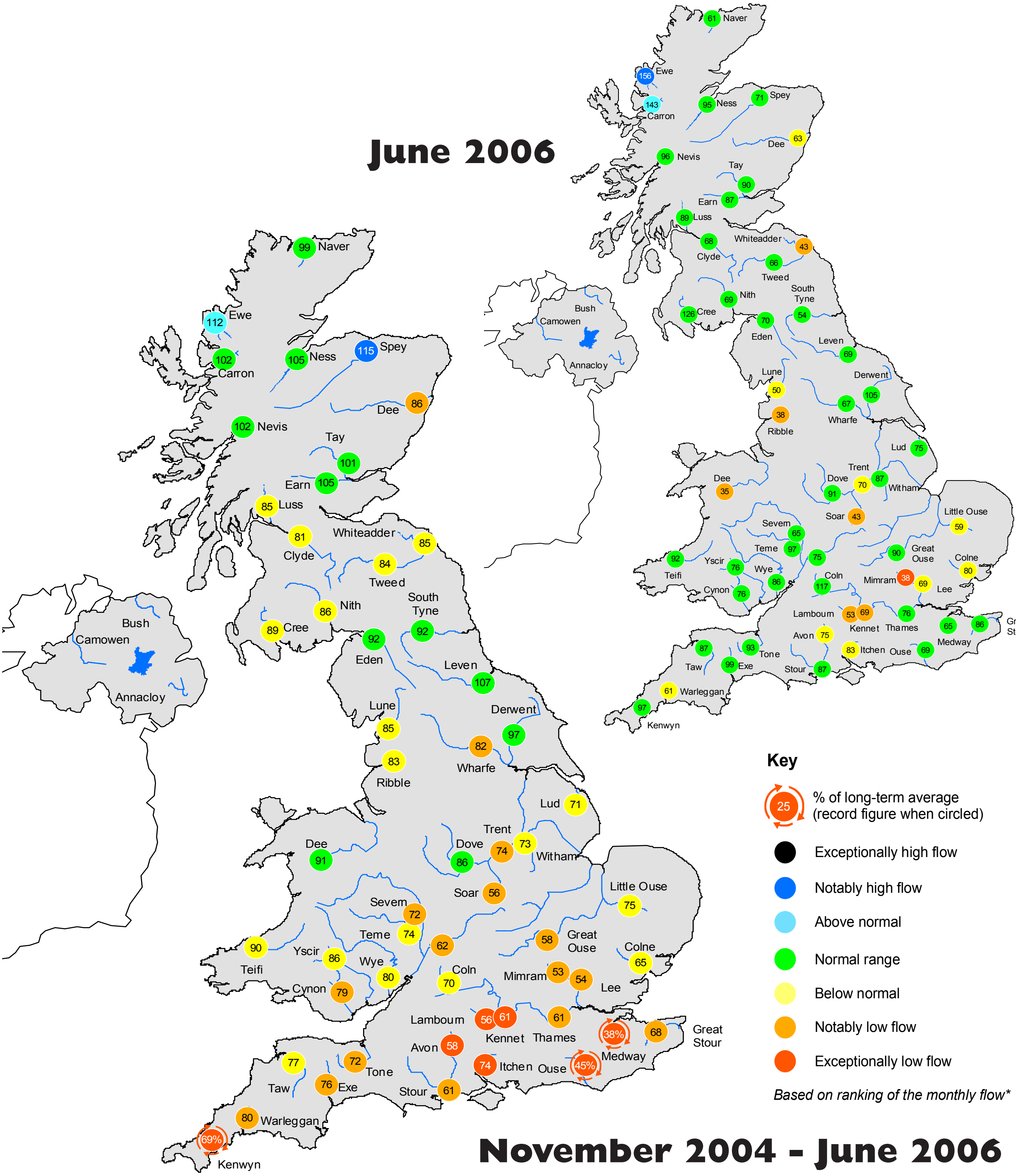


November 2004 - June 2006

Rainfall accumulation maps

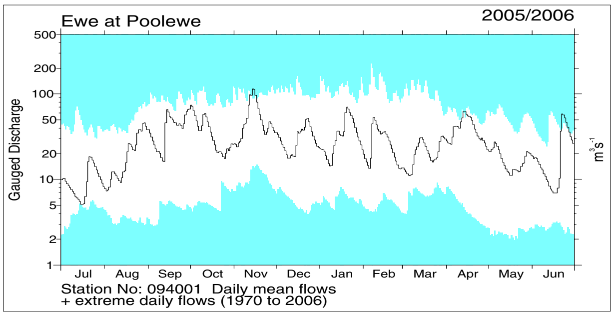
The UK rainfall total for Jan-Jun 2006 was the 3rd lowest since 1987 with particularly notable deficiencies in the south-western and north-eastern extremities. Rainfall accumulations over the last 20 months underline the long-standing exaggeration in the NW/SE rainfall gradient across the country - with rainfall totals across much of south-East and central England ranking 4th lowest (after 1920-22, 1932-34 and 1942-44) in a series from 1914.

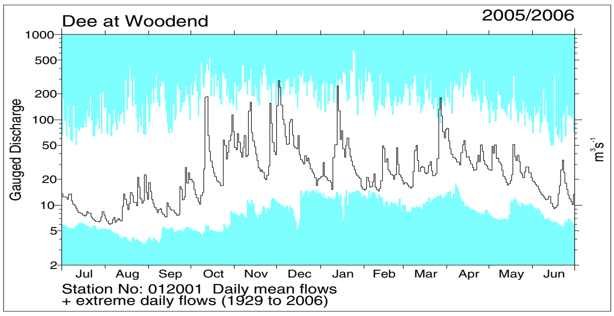
River flow . . . River flow . . .

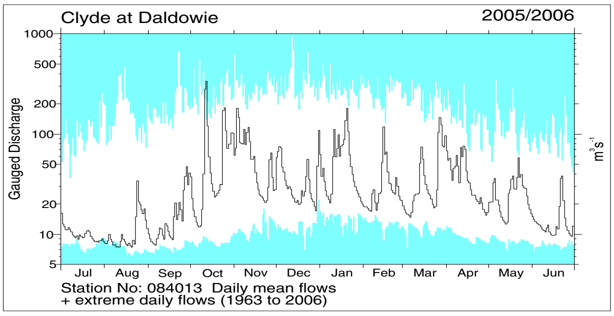


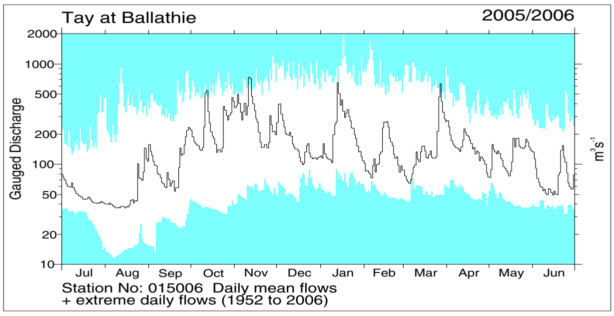
River flows

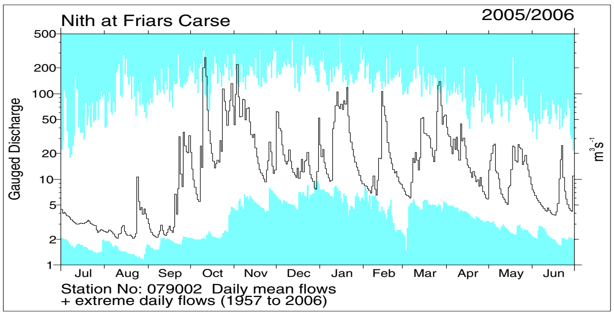
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

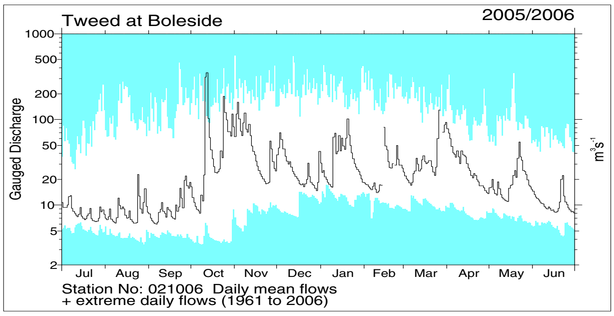


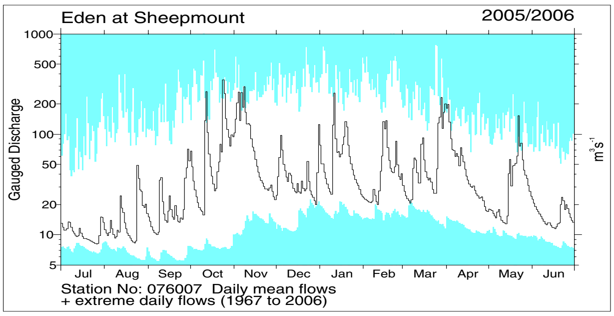


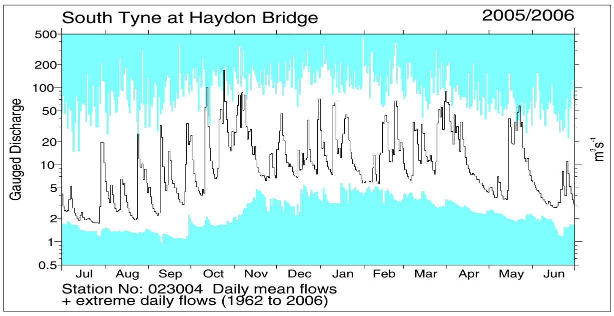


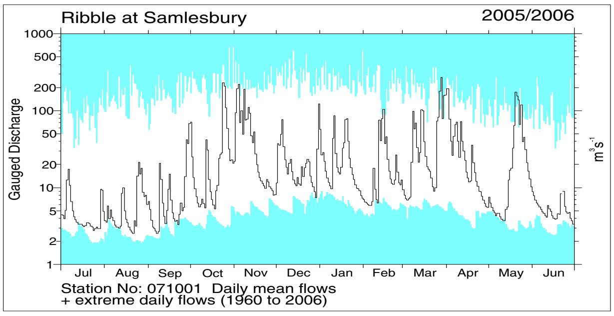


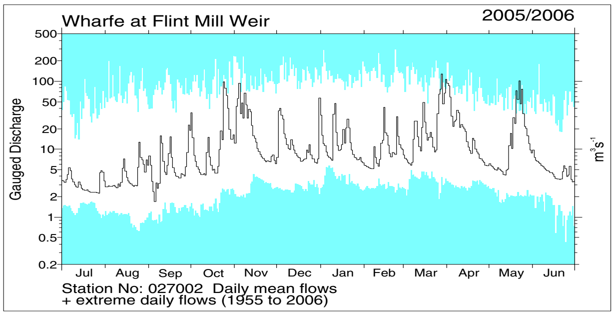








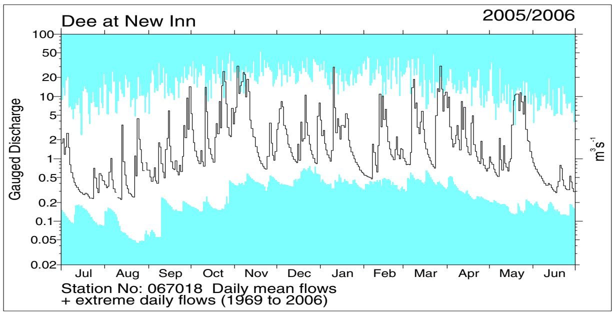


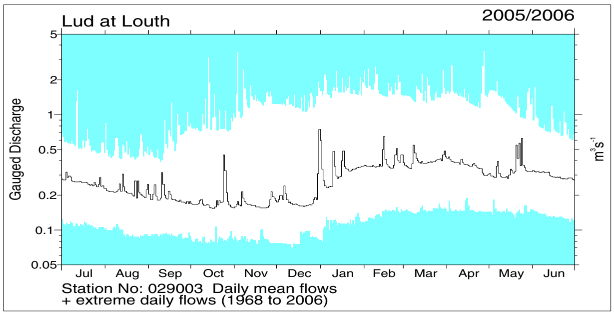


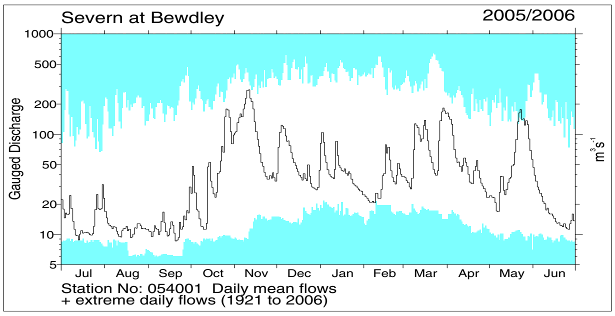
River flow hydrographs

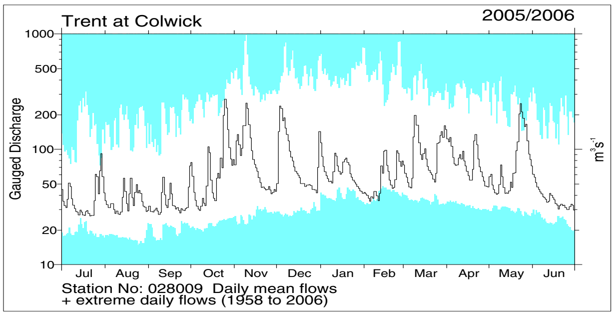
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to July 2005 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

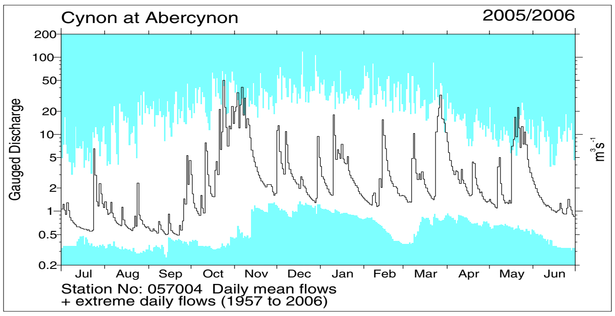
River flow . . . River flow . . .

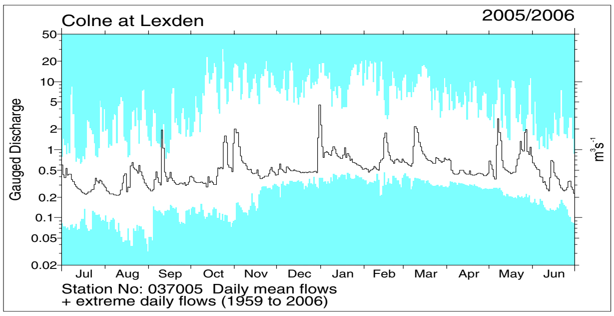


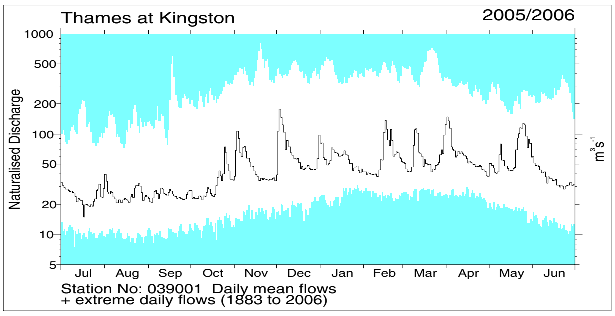


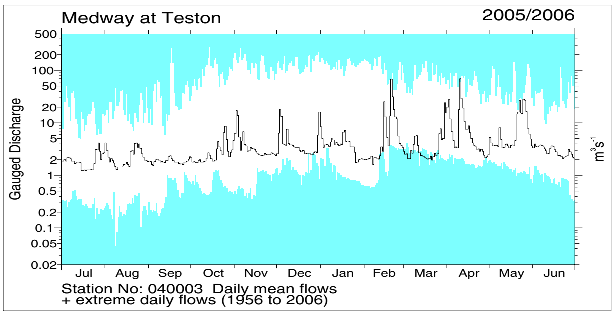


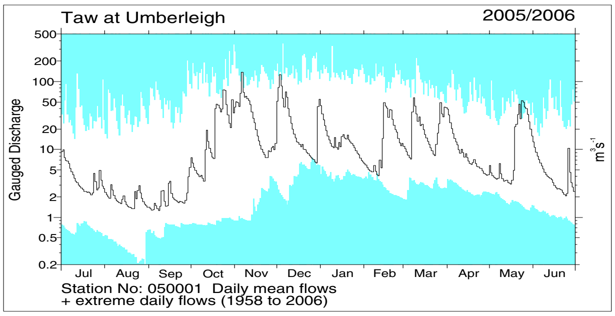


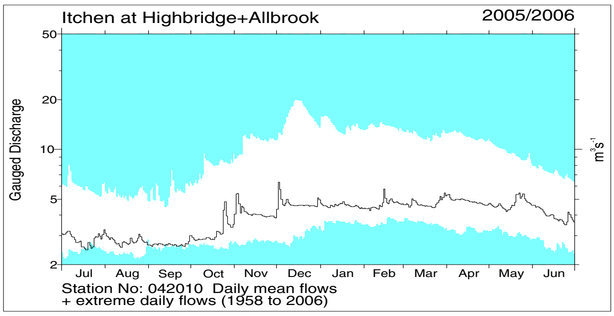












Notable runoff accumulations (a) July 2005- June 2006, (b) November 2004 - June 2006

a)

River	%lta	Rank
Forth	73	2/25
Mimram	45	2/52
Lamborn	52	2/43
Ravensbourne (Catford Hill)	56	1/26
Test	62	1/47
Cree	80	2/42
Clyde (Daldowie)	71	4/42
Naver	78	2/28

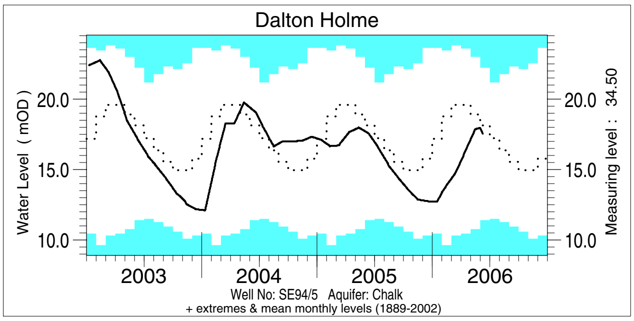
b)

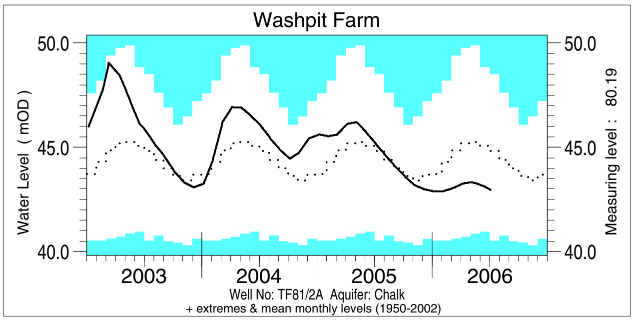
River	%lta	Rank
Soar	56	2/34
Thames (Kingston)	61	9/122
Blackwater	71	3/53
Kennet	61	2/44
Wey (Tilford)	62	2/51
Mole	64	1/29
Medway	38	1/41

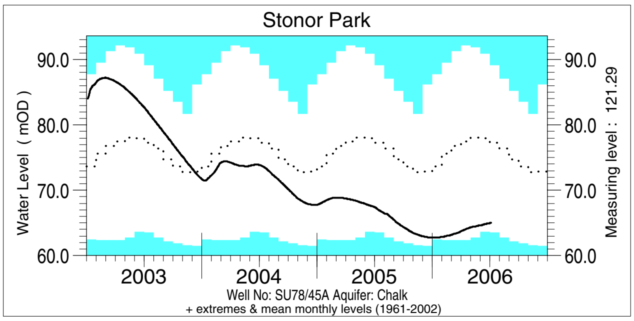
River	%lta	Rank
Ouse (Gold Bridge)	45	1/38
Wallington	46	1/47
Itchen	74	2/47
Avon (Amesbury)	58	2/40
Stour (Throop)	61	2/32
Piddle	63	1/40
Kenwyn	69	1/37

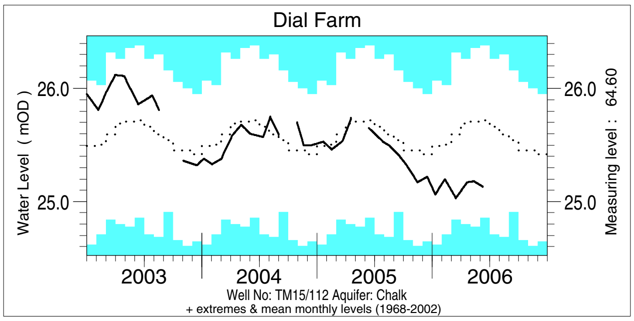
lta = long term average
Rank 1 = lowest on record

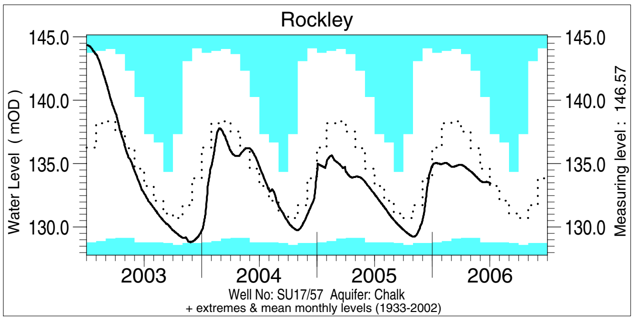
Groundwater . . . Groundwater

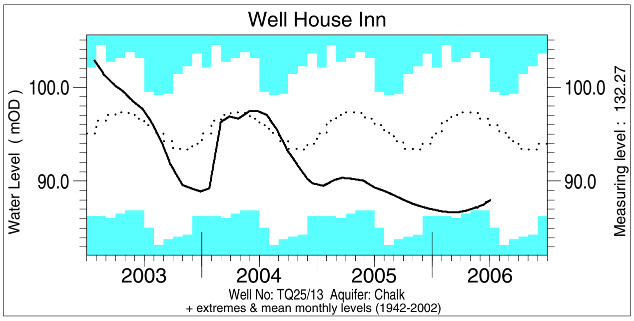


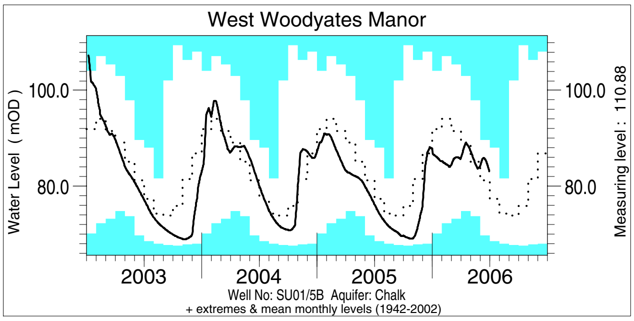


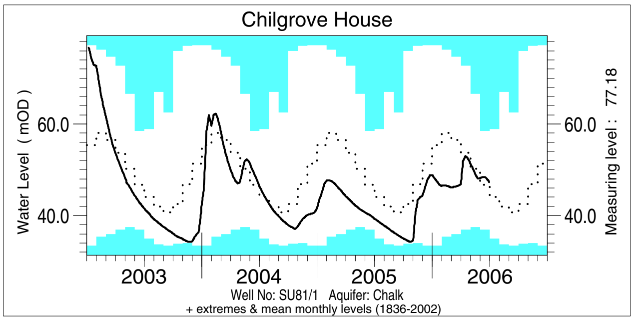


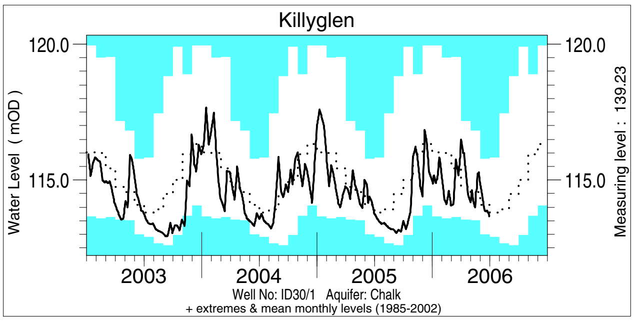


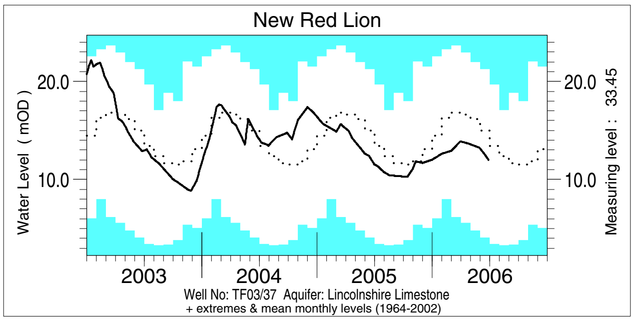






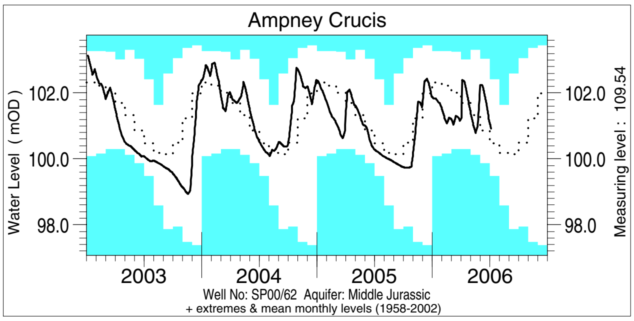


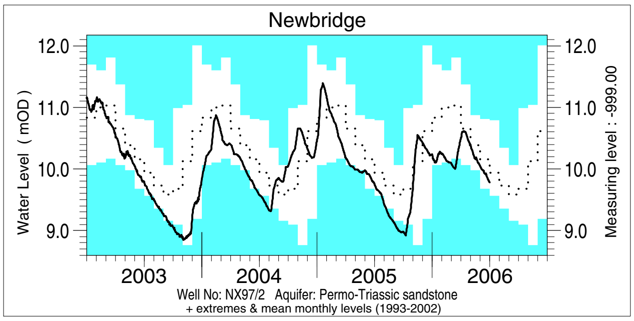


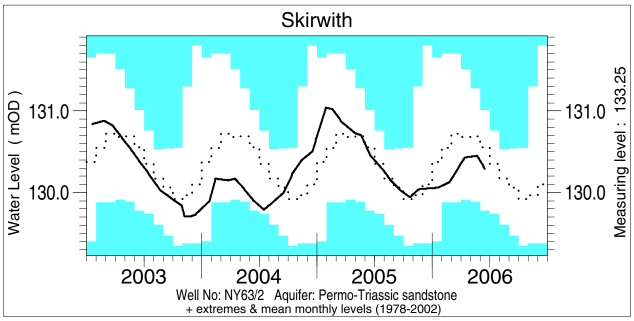


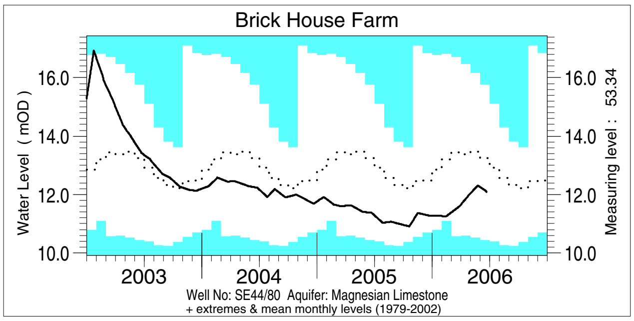
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

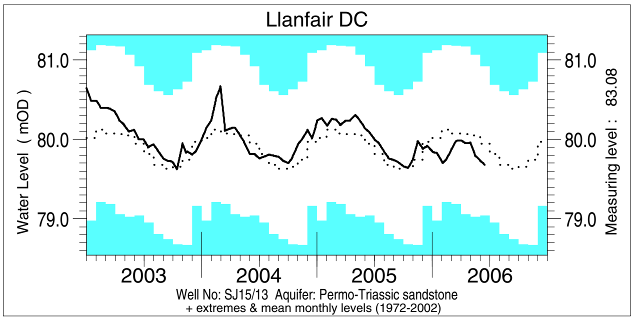
Groundwater . . . Groundwater

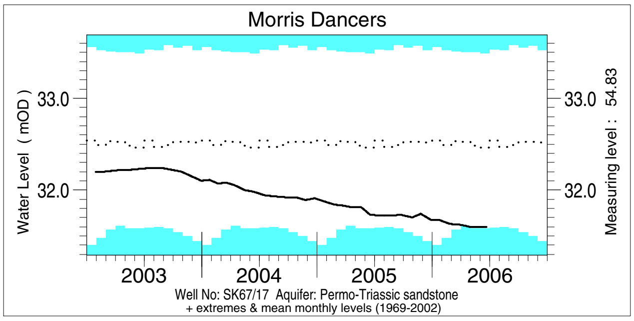


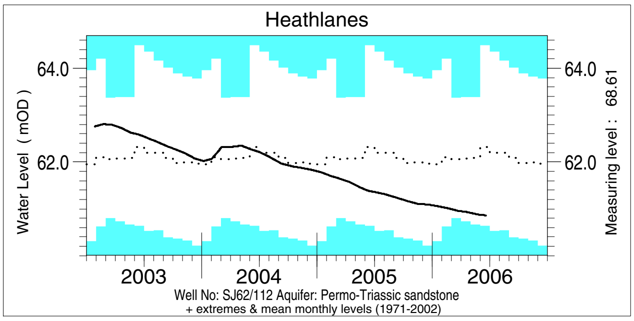


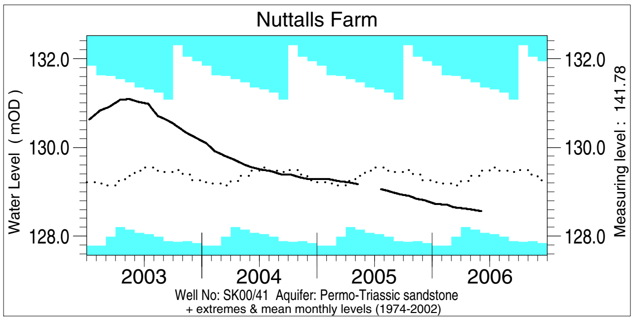


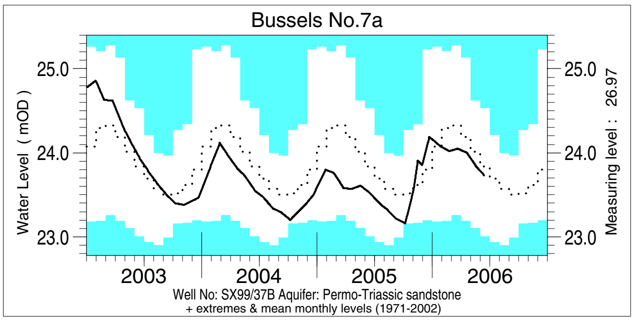


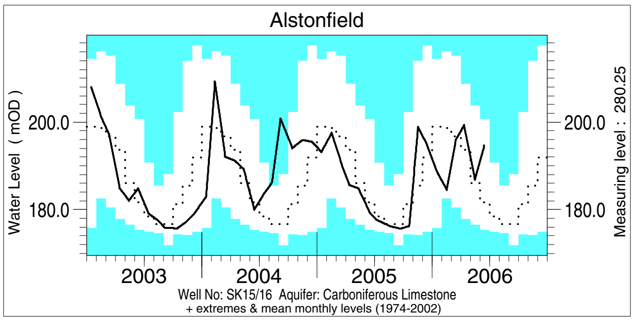










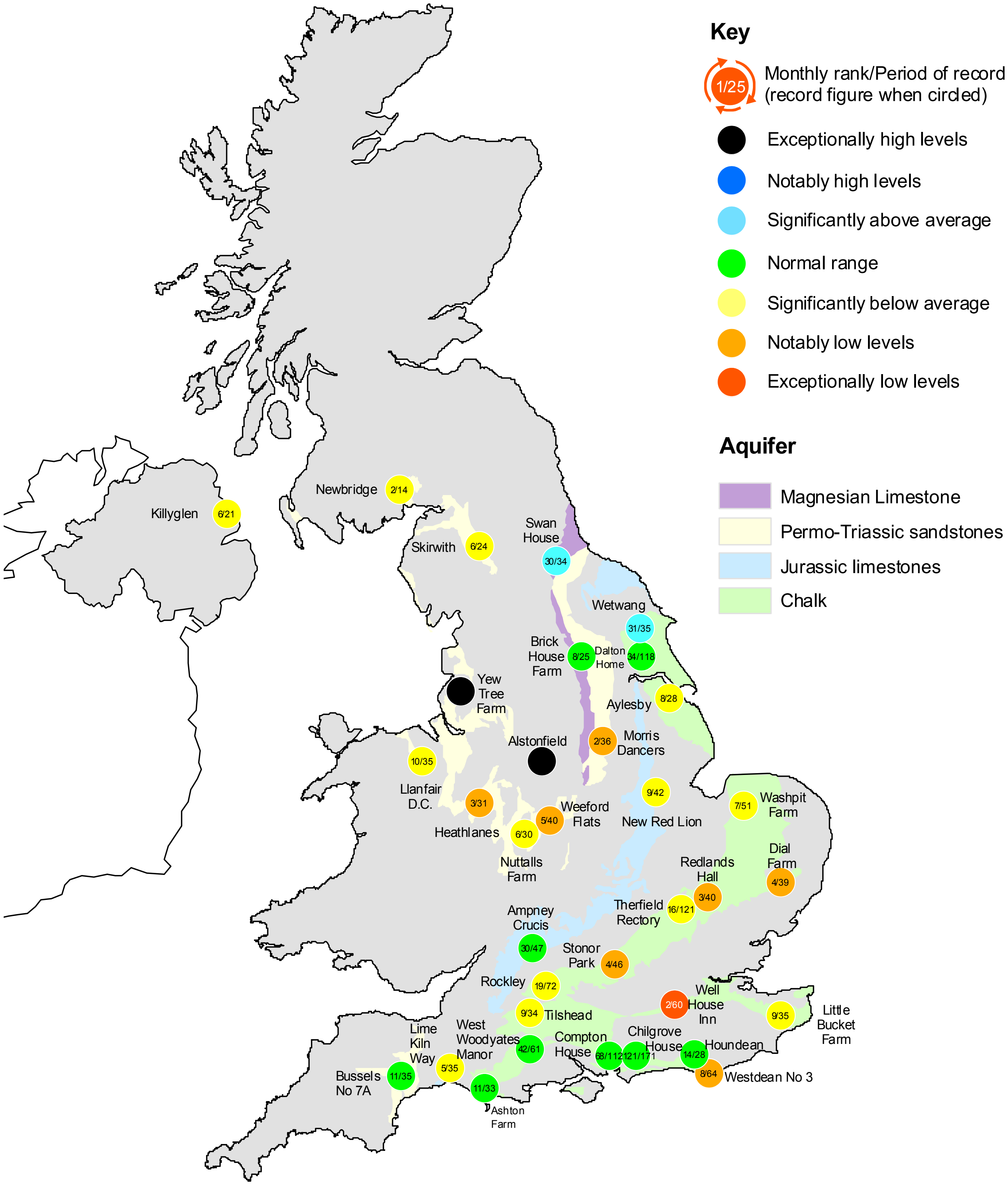


Groundwater levels June / July 2006

Borehole	Level	Date	Jun. av.	Borehole	Level	Date	Jun. av.	Borehole	Level	Date	Jun. av.
Dalton Holme	17.53	08/06	18.13	Chilgrove House	47.29	30/06	46.00	Llanfair DC	79.68	15/06	79.87
Washpit Farm	42.96	04/07	45.21	Killyglen	113.67	30/06	113.99	Morris Dancers	31.60	22/06	32.33
Stonor Park	65.01	05/07	77.99	New Red Lion	11.97	28/06	14.60	Heathlanes	60.86	20/06	62.26
Dial Farm	25.13	09/06	25.71	Ampney Crucis	100.92	05/07	100.84	Nuttalls Farm	128.56	05/06	129.63
Rockley	133.43	04/07	134.58	Newbridge	9.78	02/07	10.08	Bussels No.7a	23.73	13/06	23.86
Well House Inn	87.96	03/07	96.56	Skirwith	130.29	15/06	130.50	Alstonfield	194.64	13/06	181.48
West Woodyates	83.10	30/06	80.91	Brick House Farm	12.09	22/06	13.14				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



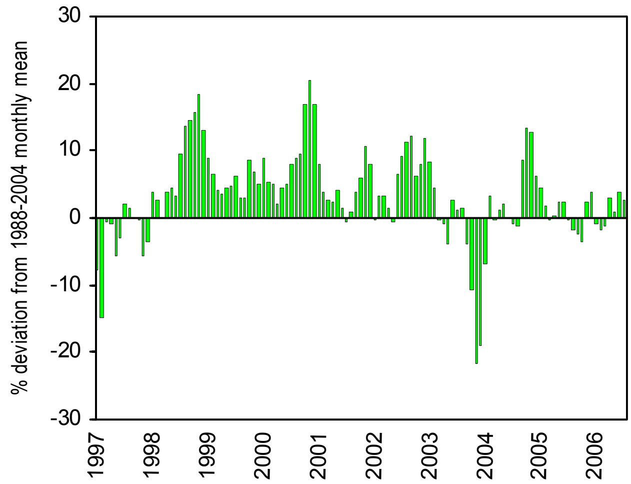
Groundwater levels - June 2006

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.

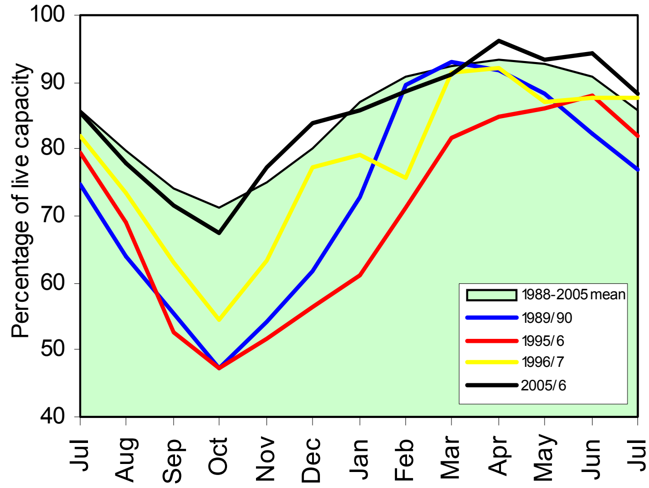
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

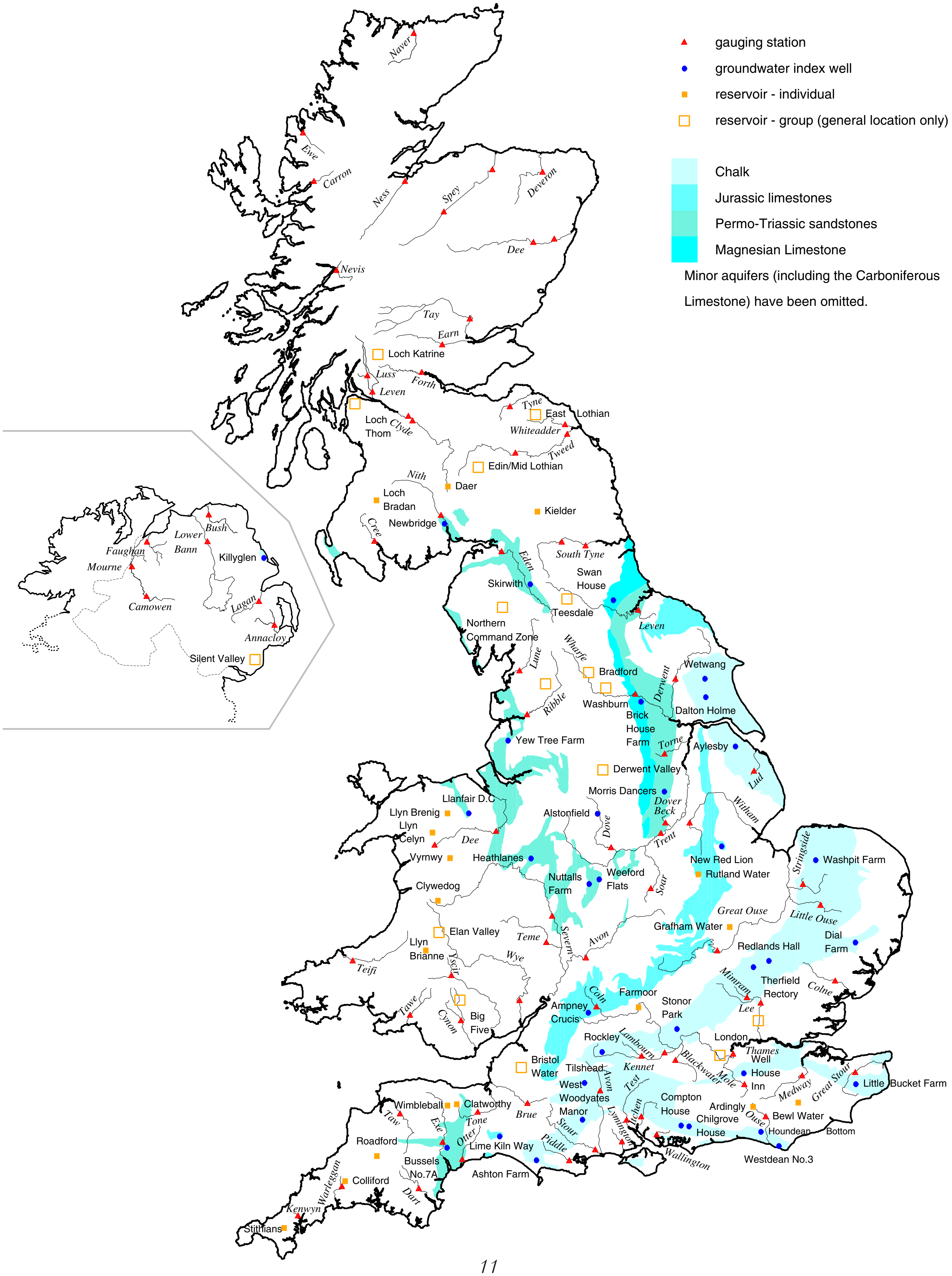
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2006 Mar	Apr	May	Jun	Jul	Avg. Jul	Min. Jul	Year* of min.
North West	N Command Zone	• 124929	90	100	91	85	**77**	71	58	1995
	Vyrnwy	55146	90	100	98	98	**86**	82	65	1990
Northumbrian	Teesdale	• 87936	100	100	94	95	**84**	77	58	1989
	Kielder	(199175)	(92)	(98)	(89)	(93)	**(90)**	(90)	(71)	1989
Severn Trent	Clywedog	44922	88	99	100	100	**97**	93	72	1989
	Derwent Valley	• 39525	98	100	99	100	**88**	79	53	1996
Yorkshire	Washburn	• 22035	89	99	94	98	**87**	80	63	1995
	Bradford supply	• 41407	83	97	95	99	**85**	77	54	1995
Anglian	Grafham	(55490)	(89)	(96)	(99)	(100)	**(96)**	(92)	(70)	1997
	Rutland	(116580)	(83)	(88)	(91)	(93)	**(88)**	(88)	(75)	1997
Thames	London	• 202406	98	99	91	93	**92**	91	85	1990
	Farmoor	• 13822	99	97	99	100	**100**	98	94	1995
Southern	Bewl	28170	50	65	85	91	**85**	82	52	1990
	Ardingly	4685	77	88	100	100	**98**	95	82	2005
Wessex	Clatworthy	5364	100	100	98	86	**95**	82	61	1995
	Bristol WW	• (38666)	(81)	(87)	(92)	(96)	**(92)**	(81)	(64)	1990
South West	Colliford	28540	62	68	70	70	**67**	81	51	1997
	Roadford	34500	71	76	75	77	**74**	81	49	1996
	Wimbleball	21320	95	100	99	100	**94**	84	63	1992
	Stithians	5205	88	96	94	90	**77**	79	53	1990
Welsh	Celyn and Brenig	• 131155	98	100	100	100	**97**	93	77	1996
	Brianne	62140	95	100	100	100	**94**	92	76	1995
	Big Five	• 69762	97	99	97	96	**81**	83	61	1989
	Elan Valley	• 99106	98	100	99	100	**89**	89	75	1989
Scotland(E)	Edinburgh/Mid Lothian	• 97639	94	96	92	92	**87**	85	54	1998
	East Lothian	• 10206	99	100	100	99	**100**	92	81	1992
Scotland(W)	Loch Katrine	• 111363	95	99	94	98	**86**	82	61	2001
	Daer	22412	99	100	97	94	**91**	82	62	1994
	Loch Thom	• 11840	100	100	100	100	**100**	85	69	2000
Northern Ireland	Total[+]	• 67270	88	93	89	89		84	65	1995
	Silent Valley	• 20634	90	98	93	94		77	54	1995

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

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 region; this can be particularly important during droughts. The storage figures relate to the 1988-2006 period only (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.

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

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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:

Hydrological Summaries
National Water Archive
CEH Wallingford
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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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07/06