Hydrological Summary
for the United Kingdom

October 2004

General
Synoptic patterns in October were dominated by low pressure – producing boisterous autumnal weather conditions and well above average rainfall in most regions. This contributed to the second wettest Aug-Oct period (after 1903) in the 105-year UK rainfall series and served to accelerate the seasonal recoveries in river flow and aquifer recharge rates across most of the country. Reservoir replenishment was substantial in almost all regions. Early November stocks remained modestly below average in some southern reservoirs (e.g. Roadford) but, despite some drawdown releases to moderate flood risk, overall stocks for England and Wales stood about 14% above average. With the exception of a few – mostly spring-fed – rivers, flows increased smartly during October and monthly runoff totals were generally well above average and, by the fourth week, flood warnings were widespread. With almost all areas at, or close to, saturation over the latter half of the month, the associated heavy infiltration has initiated, or reinforced, the seasonal groundwater level recoveries in most major aquifers. Modest soil moisture deficits persist in some eastern areas but the overall resources outlook is healthy.

Rainfall
October was a very cyclonic month with an almost unbroken sequence of vigorous frontal systems producing significant pulses of frontal rainfall. The more notable rainfall totals included 48mm at Lusa (Skye) on the 5th and 24-hr totals of 91mm at Llansadwarn (Anglesey) on the 22/23rd and 78mm at Capel Curig (N. Wales), the latter contributing to a 9-day total of 250mm. October rainfall totals were modestly below average in parts of northern and western Scotland (Allnabad, Highland Region reported 80%) and Northern Ireland (e.g. parts of the Sperrin Mountains) but elsewhere totals generally exceeded the average by a substantial margin. Large parts of eastern and central southern Britain reported >200% and Leuchars (Fife) reached 300%. For England and Wales it was, provisionally, the 3rd wettest October in the last 37 years, adding to a cluster of recent wet Octobers. More significantly, the last four months vie with 2000 as the second wettest July-Oct period since 1927; in this timeframe much of eastern Britain has been exceptionally wet. Unsurprisingly, accumulated rainfall totals over six months are well above average in all regions and, for the year thus far, the majority of regional anomalies exceed 15% (Northern Ireland and the Scottish Islands were only marginally above average in this timeframe). The large regional rainfall deficiencies built up through the 2003 drought have very largely been eliminated.

River Flow
The brisk elimination of soil moisture deficits allowed flow recoveries to gain momentum in most catchments during October. As catchments approached saturation, the threat of flooding increased – this was mitigated somewhat by high windspeeds which ensured a relatively rapid passage of most frontal systems (moderating storm rainfall totals and the magnitude of the resulting spates). Nonetheless, moderate floodplain inundations were common (e.g. on the 4/5th in the west) and the flood threat culminated around the 23rd when more than 50 Flood Warnings were in operation across England and Wales. Around half related to Wales where the estimated peak on the Tawe ranks 5th highest in a 47-yr record and severe flooding was experienced in the north (e.g. at Beaumaris, Carnarvon and on Anglesey). In coastal areas of southern England the risk of flooding was exacerbated by a combination of high tides and strong south-westerly winds – a number of tidal defences were overtopped (e.g. at Bournemouth). Away from the English Lowlands, October runoff totals were mostly well above average; a number of index rivers (including the Tweed, Witham, Tawe and Clyde – each with records >45 yrs) registered their 2nd highest October runoff. By contrast, runoff was appreciably below average in a few southern catchments and seasonal recoveries have yet to begin in some spring-fed rivers in the South-East. The Lambourn reported its 18th successive month with below average flow but, more typically, runoff accumulations over periods of 3-9 months are generally above average.

Groundwater
October rainfall totals were in the 150-200% range across many major outcrop areas and, by month end, significant (but generally below average) soil moisture deficits were restricted to drier parts of eastern and southern England – encompassing a large part of the Chalk outcrop. Infiltration rates were substantial over the latter half of the month but at many index wells and boreholes the major proportion remained in the unsaturated zone when the October levels were measured. Nonetheless, recoveries are firmly established in parts of the Chalk aquifer (e.g. West Woodyates) and autumn levels are generally well within the normal range across the outcrop – and notably high in the Yorkshire Wolds. Steep recent recoveries have left levels in most limestone index wells considerably above average and, as has been the case for much of the last two years, levels in the Permo-Triassic sandstones outcrop display large spatial variations; mostly above average (exceptionally so in some of the more north-westerly outcrops) but modestly depressed in a few areas. (Note: the Bussels borehole reported too early to reflect the bulk of the October infiltration). Levels in most minor aquifers are healthy and with most outcrop areas close to saturation, the prospects for further substantial late autumn recharge are very good.

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

Rainfall accumulations and return period estimates

Area	Rainfall	Oct 2004	Aug 04-Oct 04	RP	May 04-Oct 04	RP	Jan 04-Oct 04	RP	Feb 03-Oct 04	RP
England & Wales	**mm**	**155**	**361**		**543**		**857**		**1527**	
	%	**178**	**149**	**30-40**	**125**	**5-15**	**118**	**5-15**	**99**	**2-5**
North West	mm	**168**	547		764		1168		2072	
	%	**131**	154	30-40	127	10-20	121	10-20	100	<2
Northumbrian	mm	**154**	386		579		892		1471	
	%	**201**	165	50-80	136	20-35	128	20-35	99	2-5
Severn Trent	mm	**119**	313		466		731		1287	
	%	**181**	157	30-40	124	5-10	118	5-10	98	2-5
Yorkshire	mm	**143**	343		521		838		1429	
	%	**192**	156	30-40	129	10-20	125	10-20	100	<2
Anglian	mm	**91**	255		424		641		1085	
	%	**177**	163	35-50	138	20-35	131	30-40	104	2-5
Thames	mm	**117**	270		403		640		1125	
	%	**184**	147	10-20	111	2-5	114	2-5	94	2-5
Southern	mm	**132**	262		400		657		1237	
	%	**164**	126	5-10	109	2-5	107	2-5	94	2-5
Wessex	mm	**146**	290		439		738		1366	
	%	**181**	131	5-10	111	2-5	109	2-5	95	2-5
South West	mm	**198**	419		603		1017		1850	
	%	**169**	141	10-20	118	5-10	110	2-5	94	2-5
Welsh	mm	**232**	523		730		1197		2176	
	%	**167**	144	10-20	120	5-10	115	5-10	97	2-5
Scotland	**mm**	**208**	**567**		**832**		**1369**		**2406**	
	%	**130**	**135**	**15-25**	**121**	**10-20**	**118**	**10-20**	**97**	**2-5**
Highland	mm	**225**	460		941		1631		2868	
	%	**118**	131	30-50	119	5-10	121	15-25	99	2-5
North East	mm	**178**	401		629		1005		1662	
	%	**173**	140	15-25	125	10-20	121	10-20	95	2-5
Tay	mm	**229**	600		837		1243		2093	
	%	**169**	168	80-120	139	35-50	121	10-20	96	2-5
Forth	mm	**202**	486		731		1100		1880	
	%	**170**	147	30-40	132	20-30	120	10-20	97	2-5
Tweed	mm	**190**	460		673		1030		1705	
	%	**193**	164	70-100	136	30-40	127	30-40	100	<2
Solway	mm	**202**	602		829		1336		2384	
	%	**128**	142	15-25	120	5-10	117	5-15	98	2-5
Clyde	mm	**220**	656		974		1596		2875	
	%	**112**	126	5-10	118	5-10	116	5-10	98	2-5
Northern Ireland	**mm**	**138**	**345**		**569**		**919**		**1747**	
	%	**121**	**111**	**2-5**	**108**	**2-5**	**104**	**2-5**	**94**	**2-5**

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

The monthly rainfall figures* provided by the Met Office are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation. **All monthly totals since June 2004 are provisional (see page 12).** Revised Met Office totals for 1961-2003 have been recently incorporated. The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used to derive the CRU data series. 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

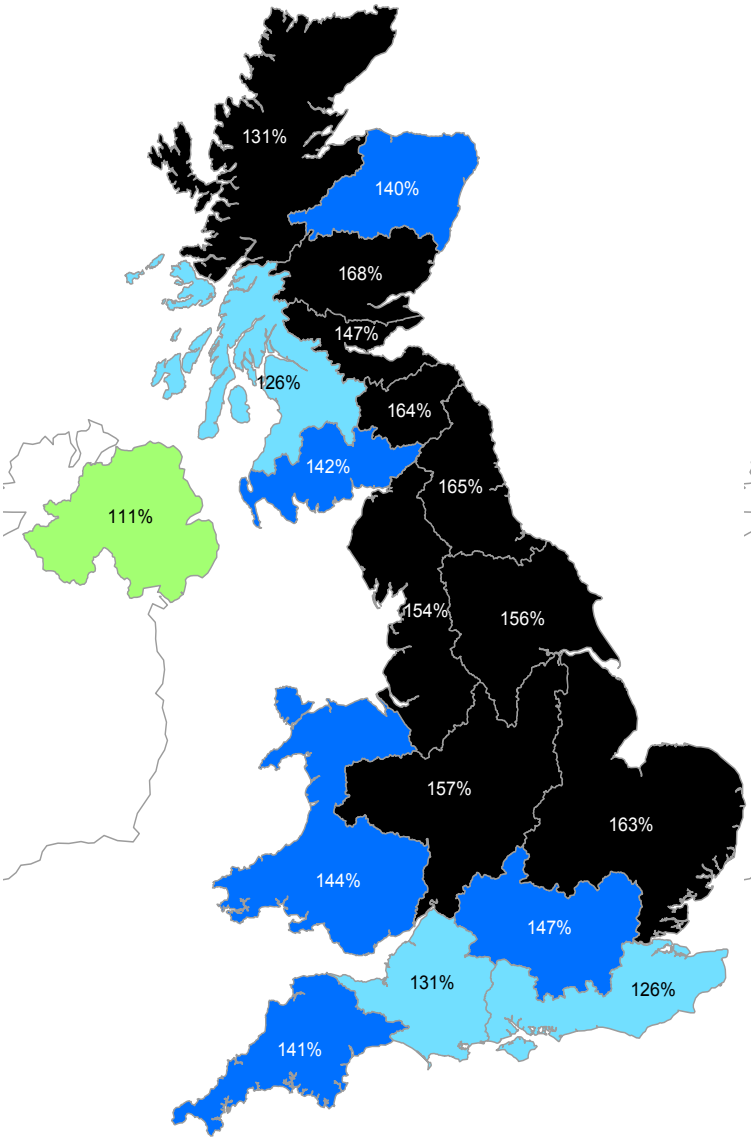
Above average

Normal range

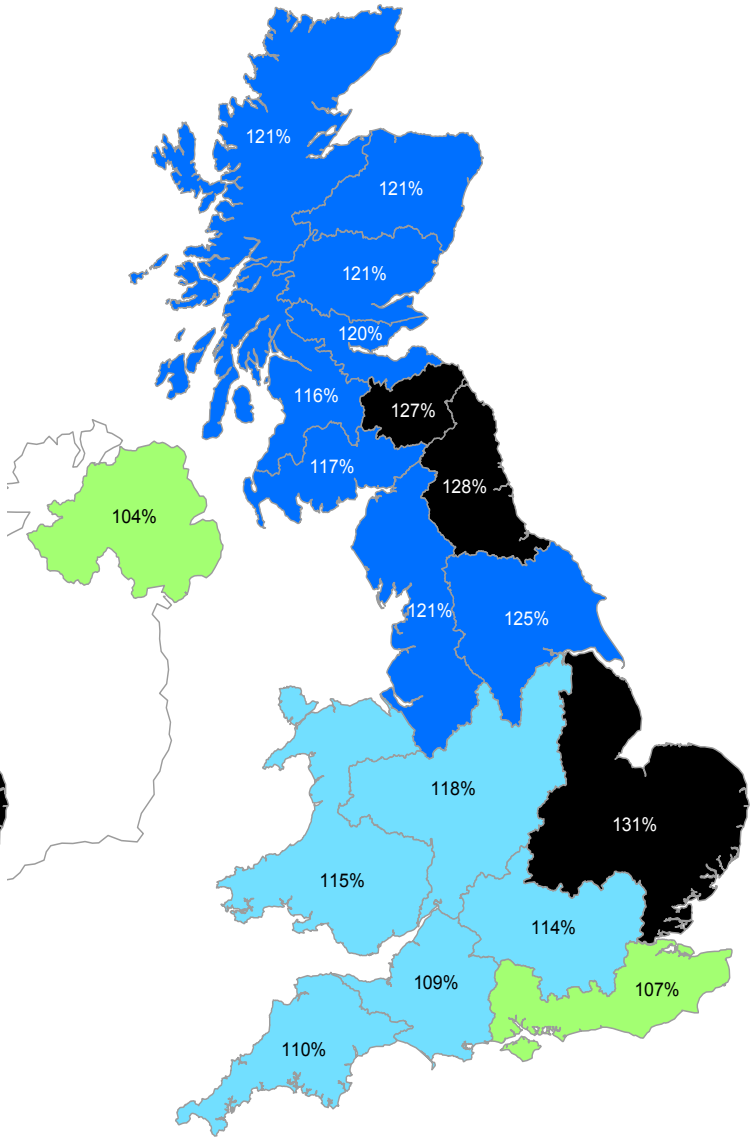
Below average

Substantially below average

Exceptionally low rainfall



August 2004 - October 2004

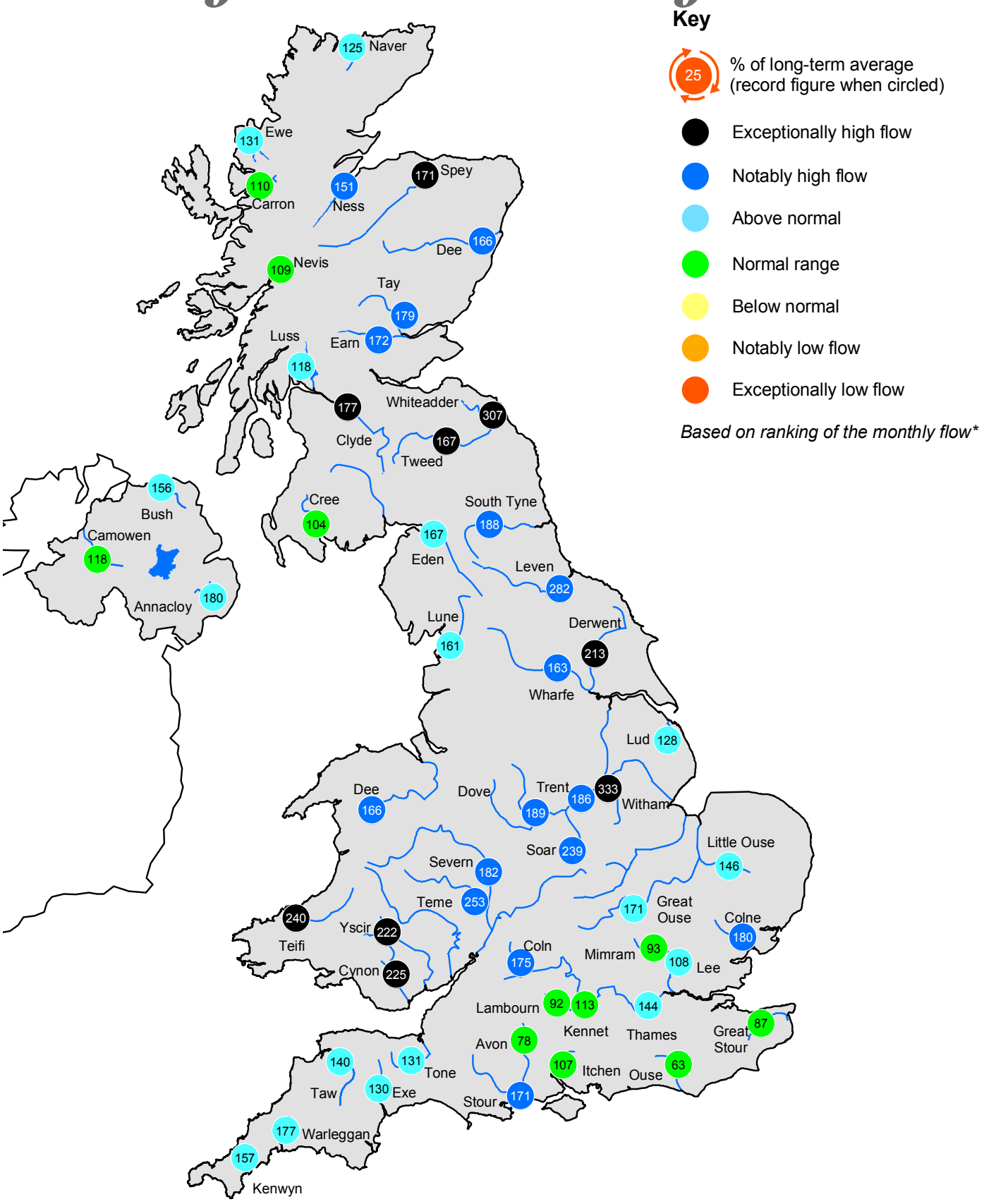


January 2004 - October 2004

Rainfall accumulation maps

Apart from Northern Ireland, August-October 2004 regional rainfall totals were well above average across the UK; for some parts of eastern Britain (e.g. the Tay basin) is was the wettest, in this timeframe, in an areal rainfall series which begins in 1961. Substantial positive anomalies also characterise most regions for the January-October period. For the UK as a whole it is the third wettest in this timeframe in the national rainfall series which begins in 1900 (2000 and 2002 were also very wet over this timespan).

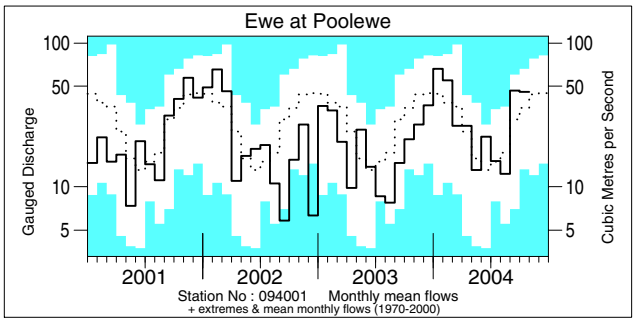
River flow . . . River flow . . .

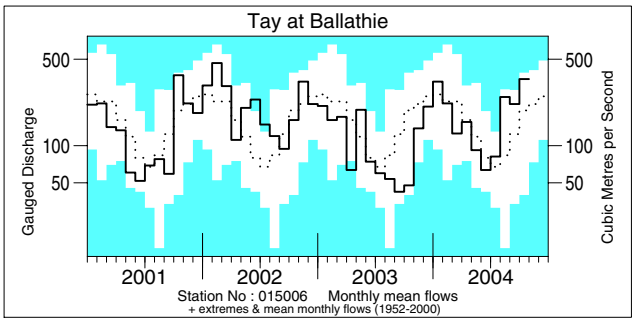


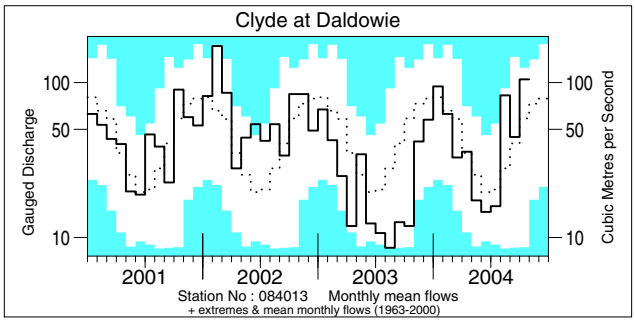
River flows - October 2004

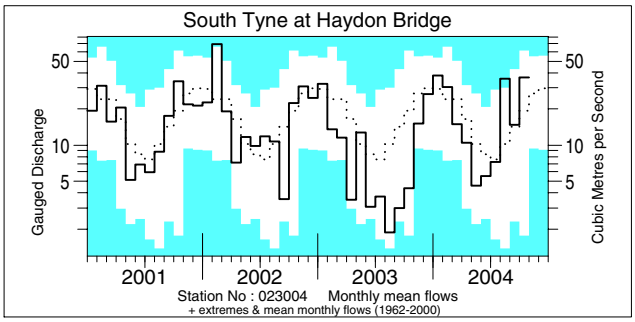
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

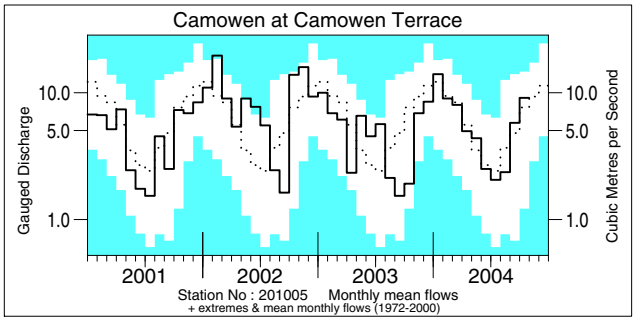
River flow . . . River flow . . .

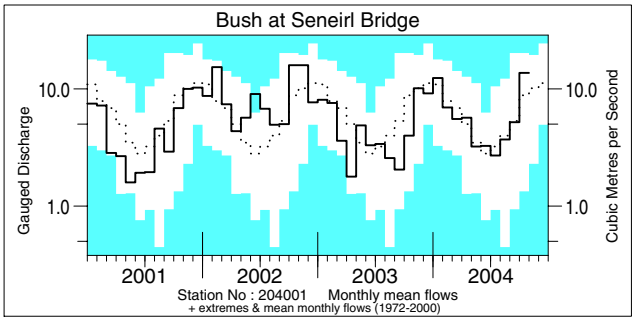


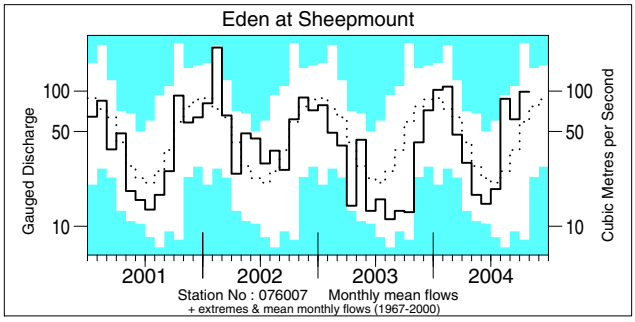


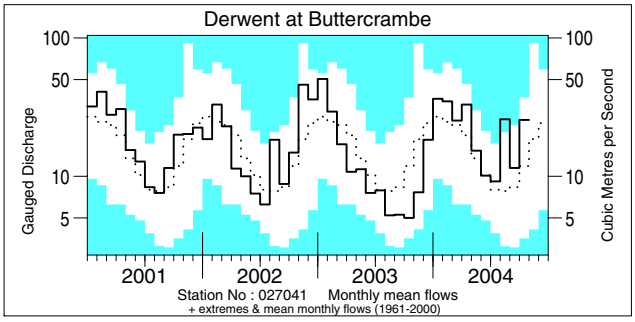


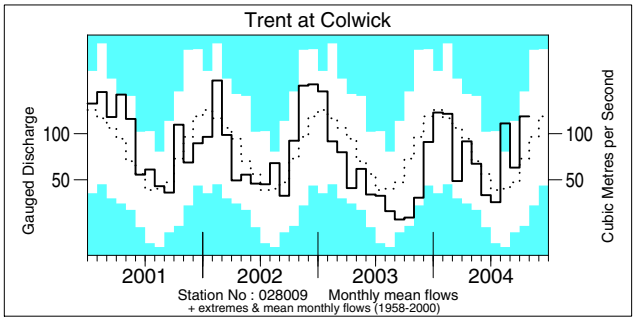


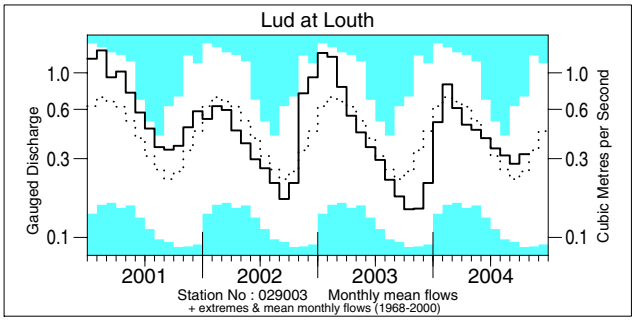








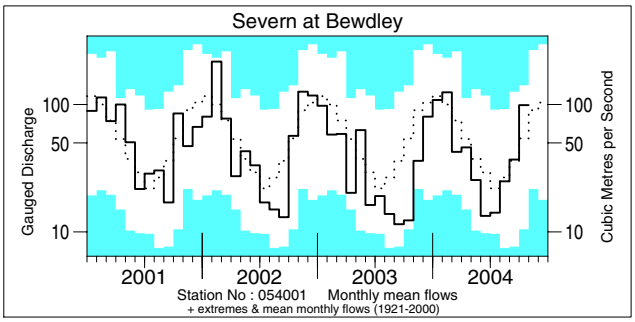


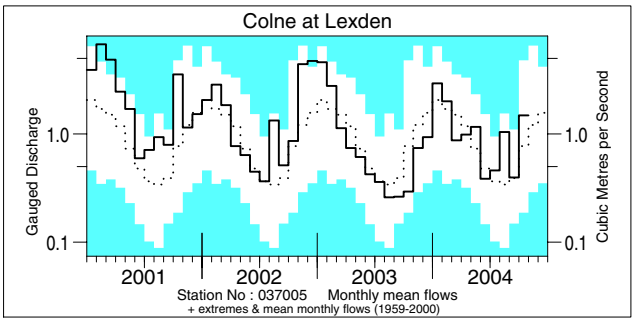


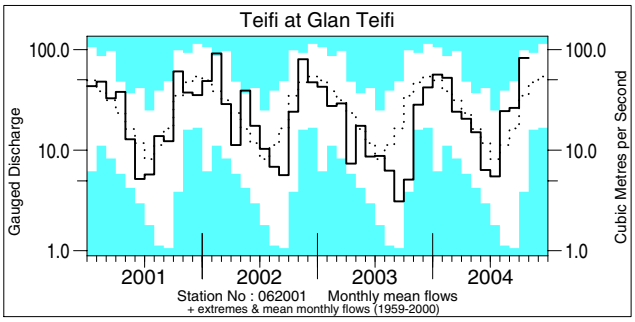
Monthly river flow hydrographs

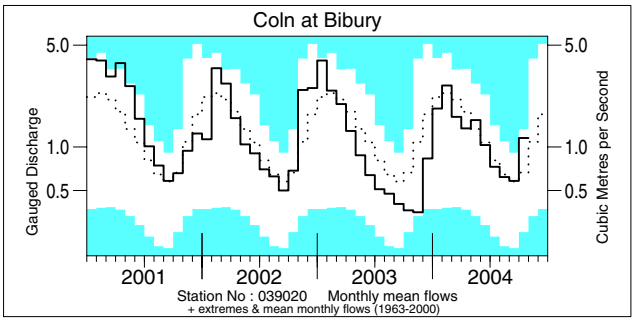
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2001 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded areas.

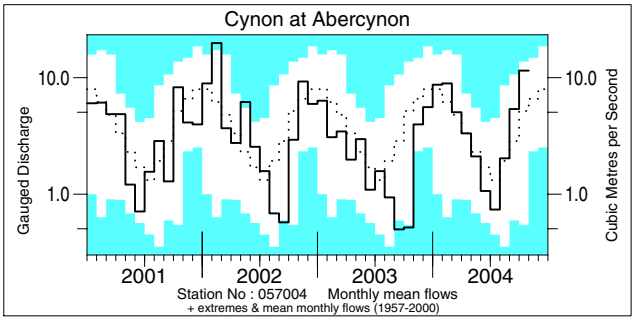
River flow . . . River flow . . .

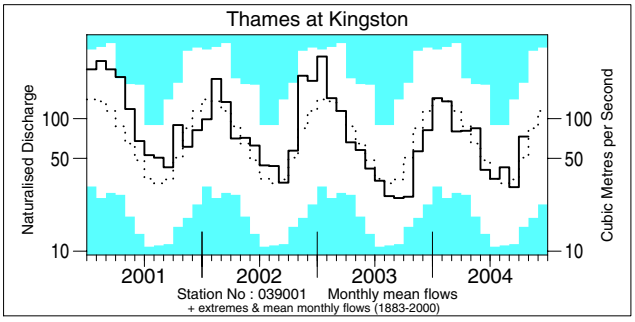


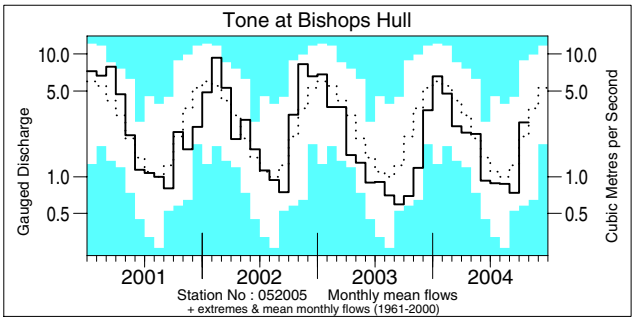


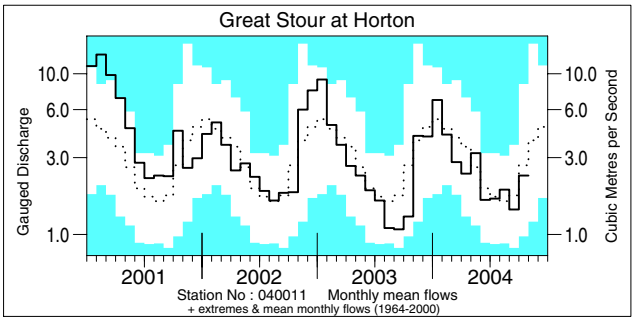


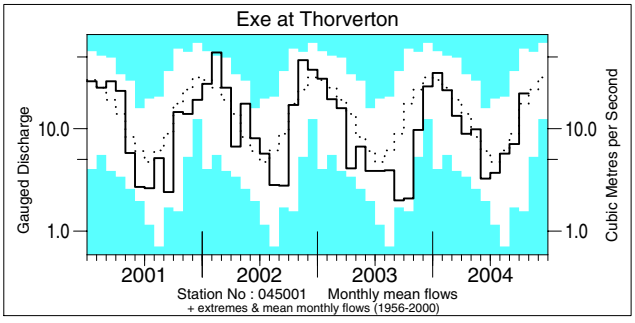


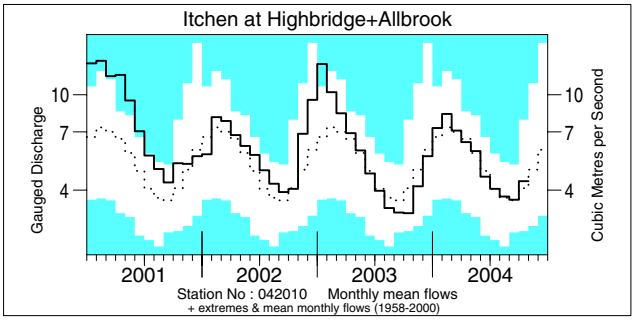










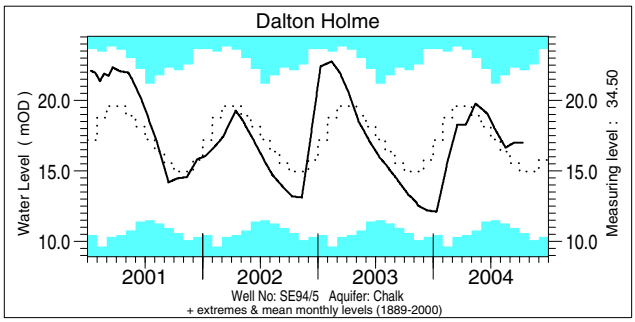


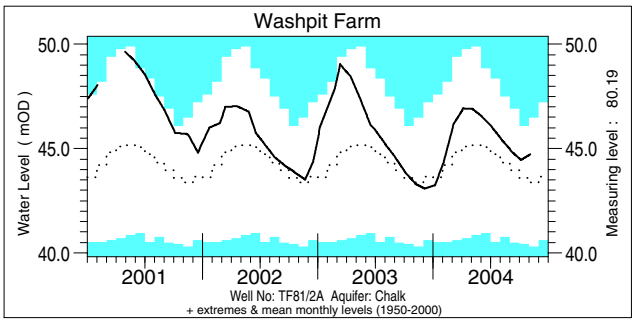
Notable runoff accumulations (a) August 2004 - October 2004, (b) May 2004 - October 2004

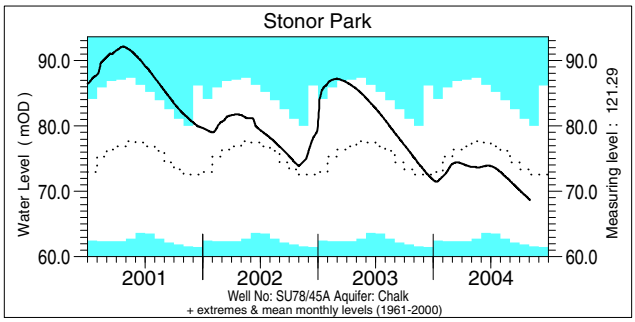
	River	%lta	Rank
a)	Ness	169	32/32
	Tay	199	51/52
	Tweed (Norham)	214	44/45
	Whiteadder	238	34/35
	Tyne (Bywell)	207	45/46
	S Tyne	195	40/41
	Derwent (Yorks)	217	43/43
	Trent	188	45/46
	Dove	223	43/43
	Torne	195	32/33
	Dover Beck	269	29/29
	Witham	342	46/46
	Teifi	212	44/45
	Eden	210	37/37
	Annacloy	188	24/25
b)	Spey (Boat o'Brig)	135	48/52
	Deveron	169	43/44
	Dee (Woodend)	132	67/75
	Leven (Linnbrane)	144	39/40
	Carron	119	24/26
	Naver	146	26/27

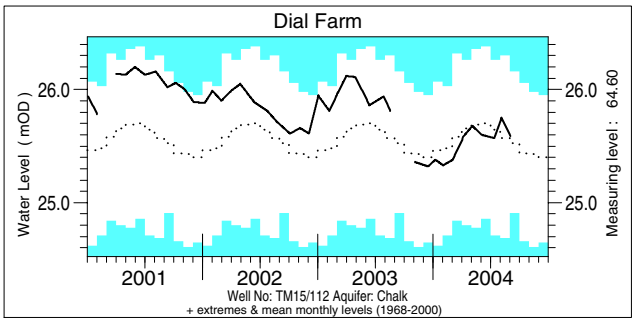
lta = long term average
Rank 1 = lowest on record

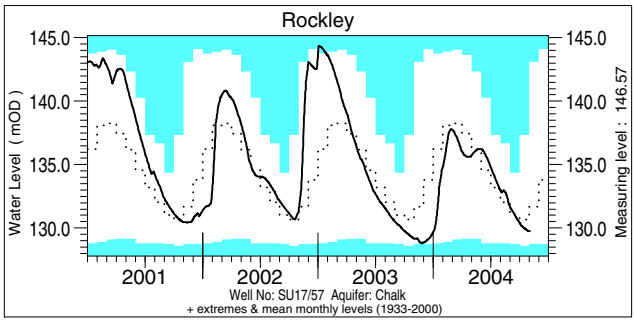
Groundwater . . . Groundwater

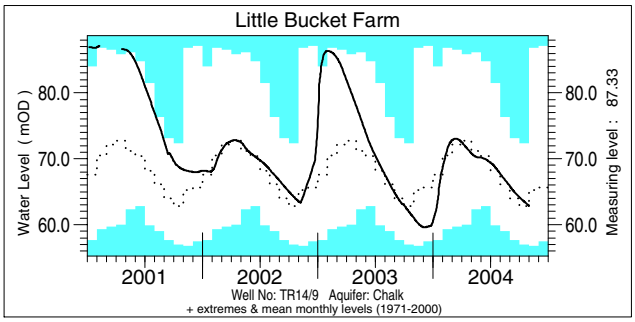


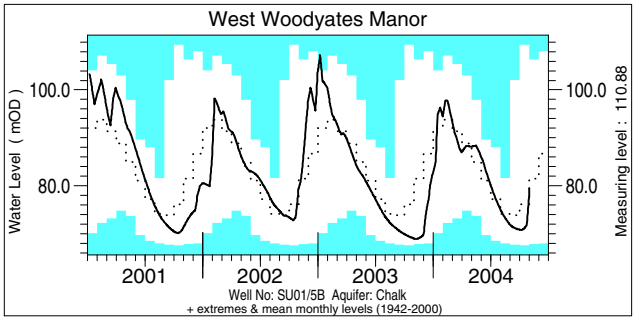


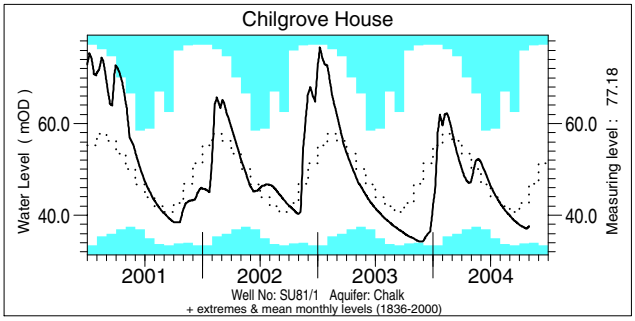


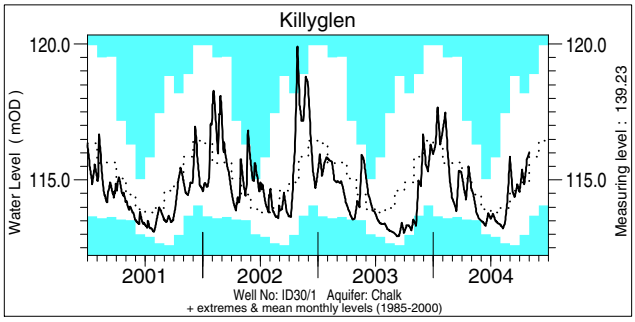


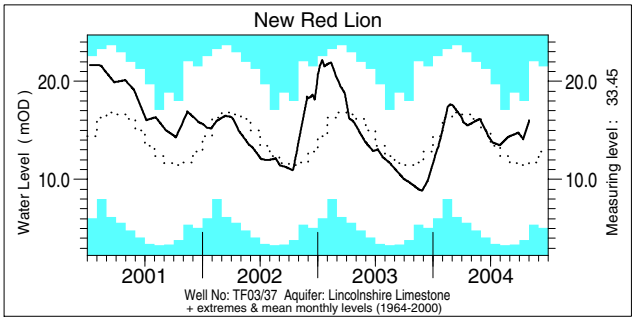






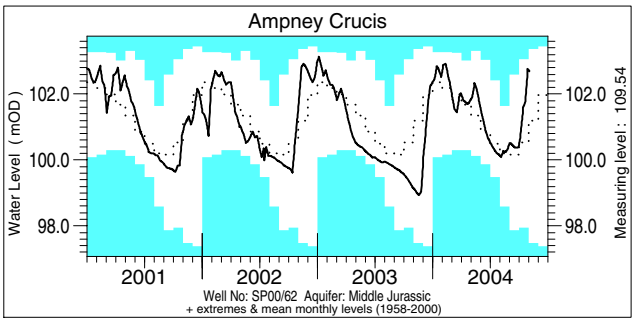


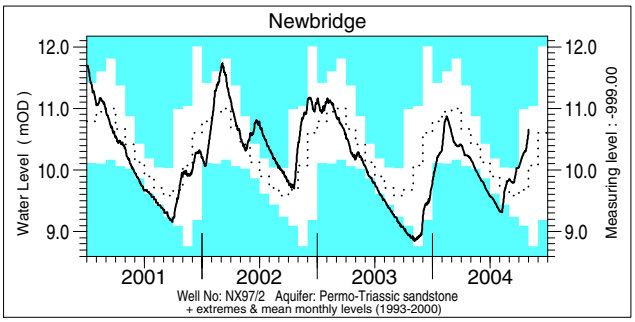


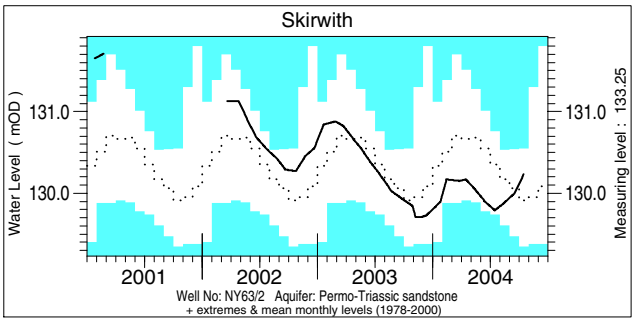


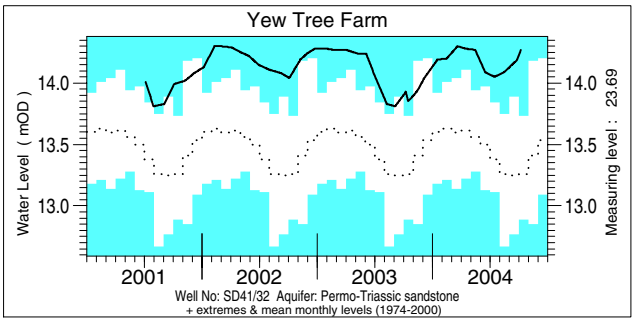
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly max., min. and mean levels are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously – the latest recorded levels are listed overleaf.

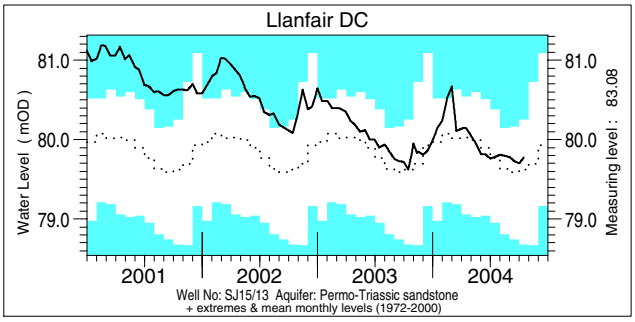
Groundwater . . . Groundwater

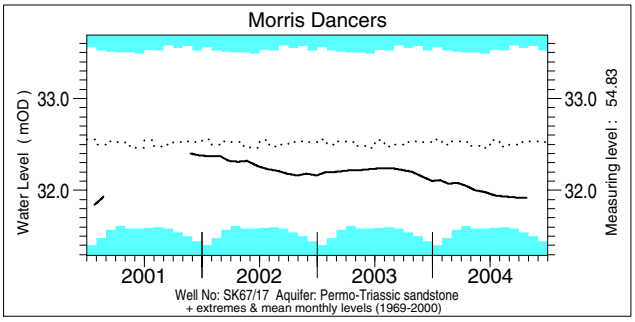


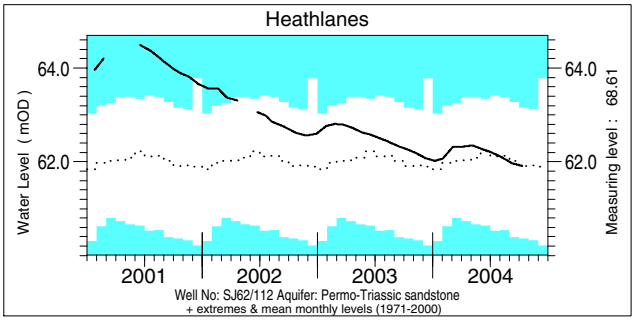


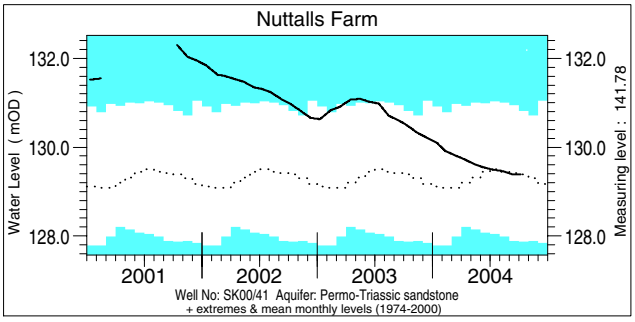


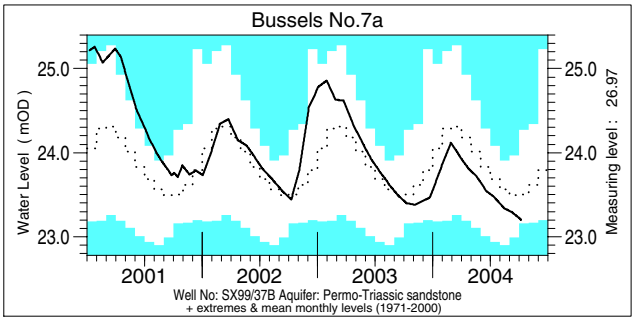


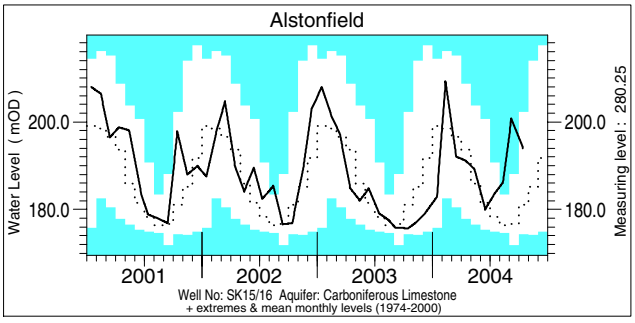










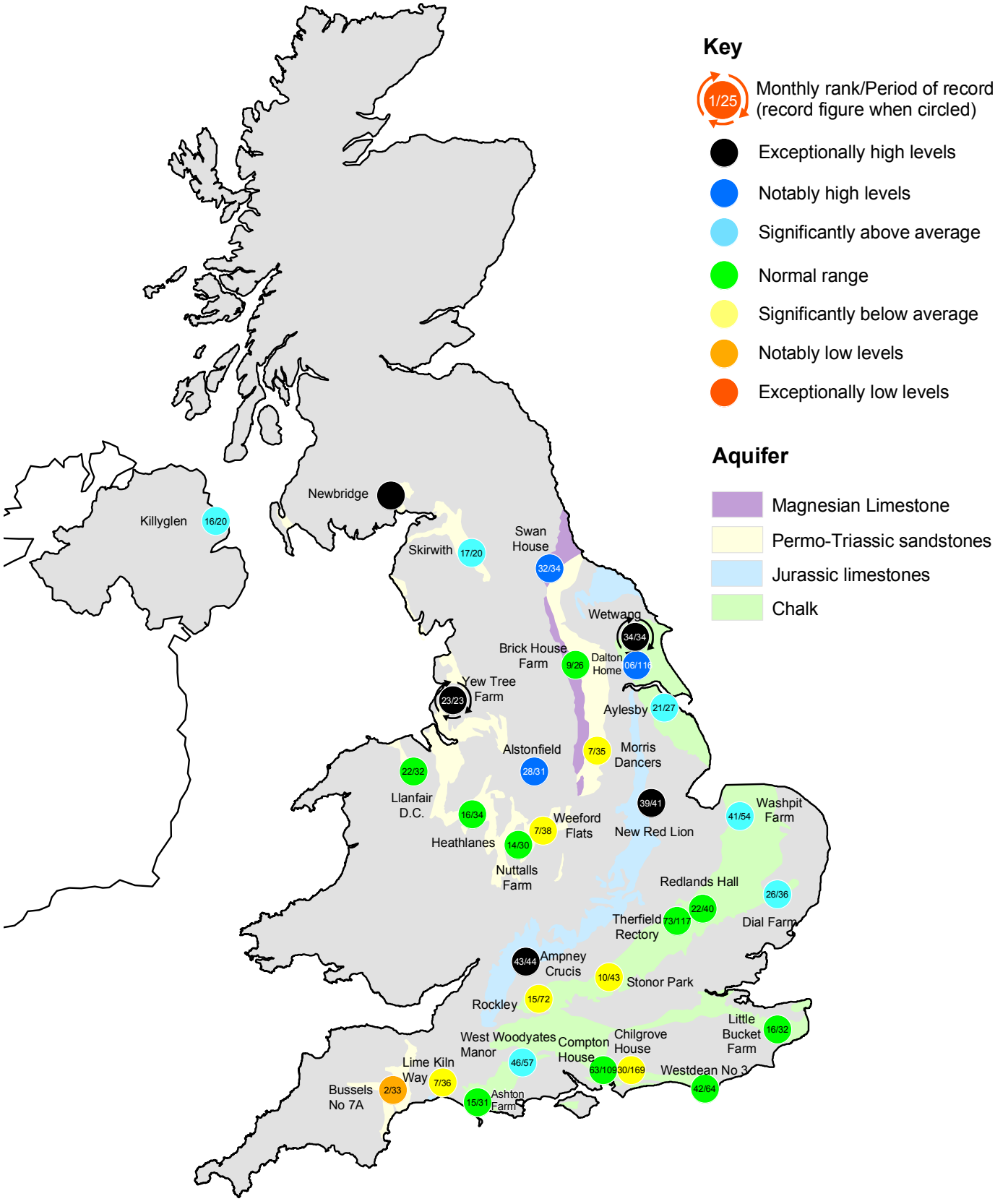


Groundwater levels October / November 2004

Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.
Dalton Holme	16.99	11/10	14.86	Chilgrove House	37.61	31/10	42.44	Llanfair DC	79.78	15/10	79.55
Washpit Farm	44.74	04/11	43.52	Killyglen	116.03	31/10	114.76	Morris Dancers	31.92	25/10	32.39
Stonor Park	68.69	02/11	73.56	New Red Lion	16.03	31/10	11.52	Heathlanes	61.91	11/10	61.98
Dial Farm	25.70	29/10	25.47	Ampney Crucis	102.69	02/11	100.41	Nuttalls Farm	129.39	06/10	129.64
Rockley	129.77	02/11	130.67	Newbridge	10.66	31/10	9.61	Bussels No.7a	23.20	07/10	23.53
Little Bucket Farm	62.85	31/10	63.53	Skirwith	130.23	14/10	129.93	Alstonfield	194.01	13/10	180.99
West Woodyates	79.44	31/10	75.05	Yew Tree Farm	14.27	06/10	13.47				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



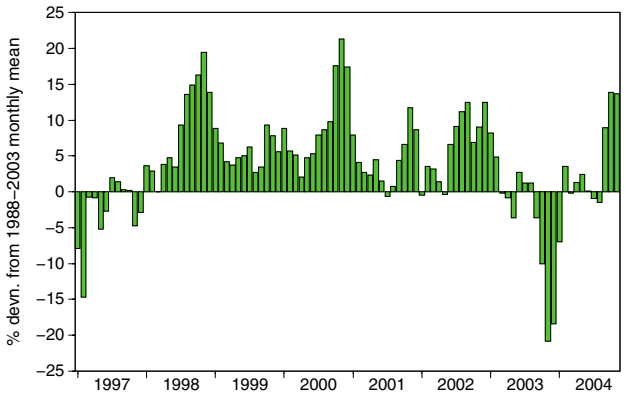
Groundwater levels - October 2004

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.

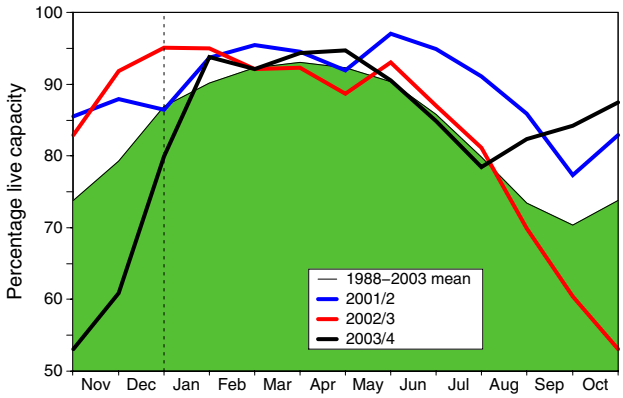
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

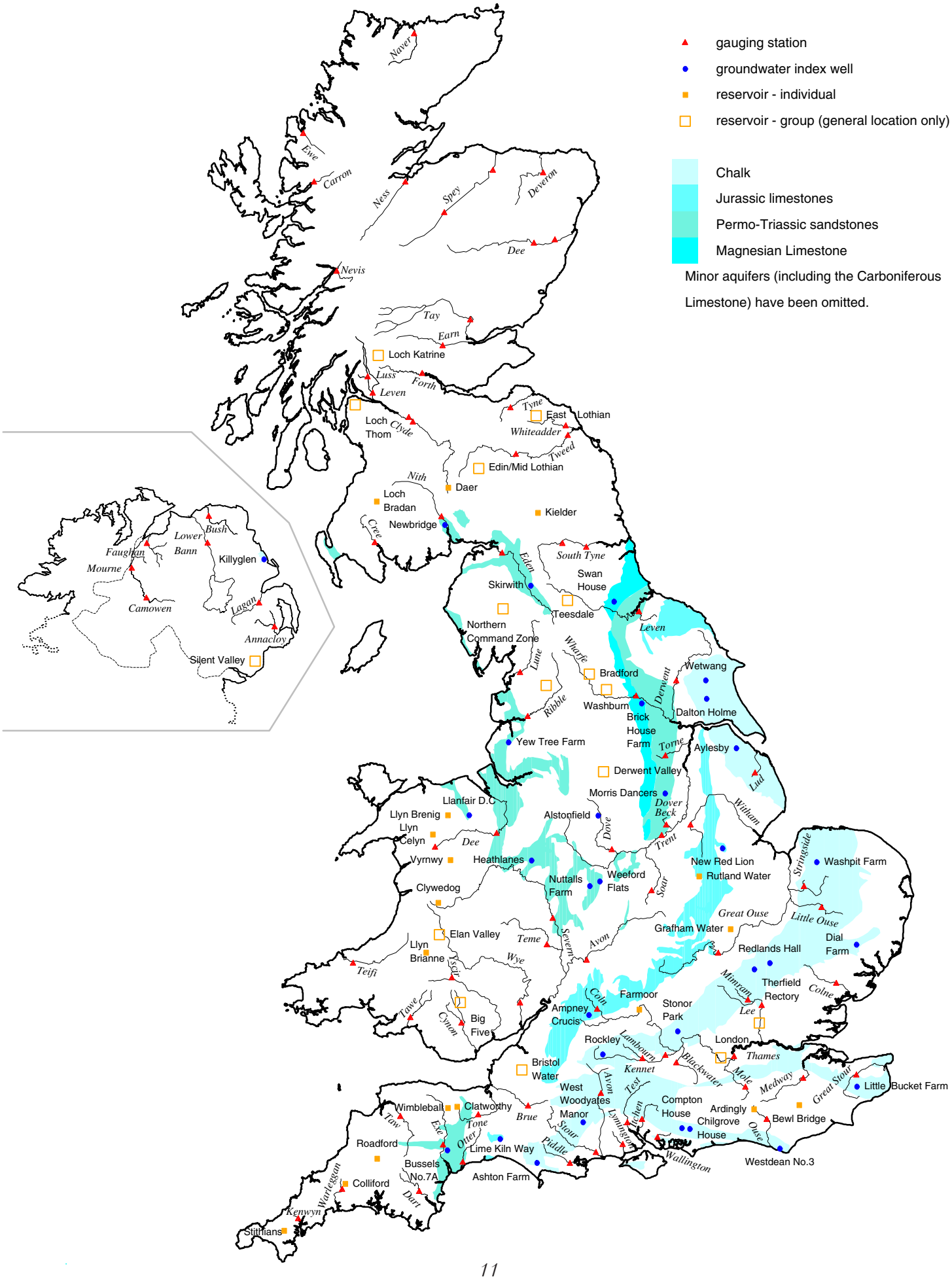
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2004 Jul	Aug	Sep	Oct	Nov	Avg. Nov	Min. Nov	Year* of min.
North West	N Command Zone	• 124929	63	55	73	86	**91**	59	33	2003
	Vyrnwy	55146	73	68	67	78	**94**	70	25	1995
Northumbrian	Teesdale	• 87936	79	68	97	97	**98**	66	33	1995
	Kielder	(199175)	(94)	(89)	(94)	(93)	**(96)**	(85)	(63)	1989
Severn Trent	Clywedog	44922	97	94	92	80	**82**	74	38	1995
	Derwent Valley	• 39525	91	83	98	93	**95**	66	15	1995
Yorkshire	Washburn	• 22035	84	79	95	85	**89**	62	15	1995
	Bradford supply	• 41407	75	67	90	91	**100**	67	16	1995
Anglian	Grafham	(55490)	(95)	(84)	(76)	(74)	**(78)**	(80)	(44)	1997
	Rutland	(116580)	(91)	(90)	(87)	(81)	**(78)**	(78)	(59)	1995
Thames	London	• 202340	89	84	84	76	**81**	74	46	1996
	Farmoor	• 13830	97	99	98	99	**96**	86	43	2003
Southern	Bewl	28170	92	87	81	74	**68**	63	33	1990
	Ardingly	4685	89	82	71	60	**60**	67	15	2003
Wessex	Clatworthy	5364	86	77	64	56	**65**	60	14	2003
	Bristol WW	• (38666)	(81)	(75)	(66)	(57)	**(56)**	(60)	(24)	1990
South West	Colliford	28540	67	60	55	50	**60**	70	42	1996
	Roadford	34500	62	56	51	55	**57**	71	18	1995
	Wimbleball	21320	87	79	69	63	**73**	65	26	1995
	Stithians	5205	78	68	57	50	**60**	55	18	1990
Welsh	Celyn and Brenig	• 131155	88	83	82	92	**97**	80	48	1989
	Brianne	62140	88	81	85	100	**99**	88	57	1995
	Big Five	• 69762	82	68	71	82	**87**	70	38	2003
	Elan Valley	• 99106	87	79	81	100	**100**	83	37	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	74	69	80	94	**87**	78	48	2003
	East Lothian	• 10206	100	97	100	100	**100**	79	38	2003
Scotland(W)	Loch Katrine	• 111363	74	66	74	94	**97**	83	40	2003
	Daer	22412	75	65	90	100	**100**	87	42	2003
	Loch Thom	• 11840	88	93	100	100	**100**	87	69	2003
Northern Ireland	Total+	•	72	62	72	73	**85**	76	39	1995
	Silent Valley	• 20634	56	48	58	64	**73**	65	34	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 1988-2004 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 ans regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available 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:

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OX10 8BB

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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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