Hydrological Summary

for the United Kingdom

August 2004

General

August was a remarkably unsettled month – provisionally, the wettest August for the UK since 1956. Many new local and catchment rainfall records were established, particularly for high intensity events. Much of the precipitation was convective and downpours of tropical intensity affected many parts of the country. Near-saturated soil conditions damaged crops and/or delayed harvesting in some regions. Drainage systems were (briefly) overwhelmed in many urban areas and flood warnings widespread after the first week. A major rescue operation was needed to prevent a significant death toll at Boscastle in Cornwall on the 16th. More extensive floodplain inundations were also common, in north-eastern Britain particularly – a very unusual occurrence in August. Counter to the usual seasonal trend, most reservoir stocks increased appreciably through August; a few reservoirs (e.g. Loch Thom) reached capacity and overall stocks for England & Wales stood around 9% above average entering September. However, some gathering grounds missed the more intense storms and reservoir levels fell considerably in some areas – the South West especially. Some aquifer outcrop areas reported dramatic declines in soil moisture deficits but, generally, infiltration in August was modest leaving groundwater resources well within the normal late summer range – but displaying substantial spatial variability. Entering the autumn the water resources outlook was healthy.

Rainfall

A combination of humid sub-tropical air masses, slow-moving frontal systems and several hurricane remnants made for exceptional precipitation conditions in August. Many remarkably intense downpours were reported (their impact exacerbated in some cases by hail – a 45mm diameter hailstone was reported at Bracknell on the 5th). Notable precipitation totals include: 42mm in 38 minutes at High Wycombe (3rd), a possible 67mm in 45 minutes near Huddersfield (12th); 24-hr totals of 73mm (Wheatley, Oxen), 77mm (Sheffield) and 91mm (Wittering, Cambs) during the 9/10th . Over this 2-day period a slow-moving front generated rainfall totals >50mm in many areas; Skipton (Yorks) registered 96mm in 36 hrs. The most outstanding August event was a 200mm storm total in around 4 hours at Otterham, north Cornwall on the 16th (return period >5000yrs). Rainfall accumulations were also exceptional over much longer timespans – In Dumfries and Galloway, Boreland recorded a 16-day total of 248 mm (RP: > 200 yrs) and many localities reported record August totals (e.g. Wittering in an 80-year series). For the UK, August rainfall was around 180% of average but a few areas reported <70% (e.g. the north-eastern tip of Scotland, parts of Fermanagh). By contrast, much of eastern Britain especially exceeded twice the average and rainfall totals for many gauged catchments were amongst the three highest on record for *any* month. The abundant rainfall ensured that summer (Jun-Aug) rainfall totals were well above average in all regions and longer term deficiencies (e.g. from Feb 2003) were substantially reduced.

River flow

Following sustained July recessions, flows in most rivers were considerably below the monthly average at the beginning of August. Widespread thundery activity produced many locally intense runoff events on the 2-4th – triggering severe urban flooding and generating massive transport disruption (e.g. in north-west London on the 3rd). Storm runoff and sewage overflows also depleted river oxygen levels; a large fish kill occurred on the Thames Tideway on the 3/4th. Notable urban flooding continued throughout the month (e.g. in Wycombe, Redruth, Sheffield, Londonderry). Widespread fluvial flooding is rare in August (some parallels can be drawn with 1961 and 1931) but, with rainfall intensities exceeding infiltration capacities and headwater areas becoming saturated, flood risk increased rapidly. Bankfull flows were exceeded in many rivers in eastern Scotland and northern England during the second week. On the 11th, the Tay reported its highest August flow (>1000 m3s-1) in a 52-yr record; other rivers establishing new August maxima included the Earn, Trent and Ribble. On the 16th (the 52nd anniversary of the Lynmouth disaster), extreme runoff in the Valency and Jordan resulted in severe structural damage at Boscastle (where there is a history of significant flooding – its location and topography make it particularly vulnerable to high-intensity storms). Many flood warnings (and Flood Watches) were in operation in mid-month and surface runoff, landslips and mudslides were widely reported; a pair of major landslips trapped many travelers on the A85 near Lochearnhead. Despite very modest flows at the beginning of the month, gauging stations closely approaching, or exceeding, August runoff maxima showed a wide distribution – from the Midlands to northern Scotland. Summer runoff totals are mostly in the normal range but 12-month accumulations remain well below average for many rivers across the UK.

Groundwater

August rainfall totals were 130-200% of average over most (but not all) major aquifer outcrop areas but local variability was large. In marked contrast to the normal seasonal pattern, soil moisture deficits declined in August – dramatically in some outcrop areas (e.g. parts of Cambridgeshire). Generally however, substantial deficits remained at month end; in parts of the south-western Chalk they remained above the late summer average. Infiltration rates were high relative to the August average (which is negligible for most outcrops) but very modest in absolute terms. Many reporting dates were too early to capture any impact of the August rainfall but groundwater hydrographs for some of the more responsive aquifer units provide evidence of a very early seasonal upturn in groundwater levels e.g. at Ampney Crucis, Killyglen, Newbridge and Alstonfield where a new maximum August level was reported (in the second week). Elsewhere, the August levels confirm the continuation of a typical summer recession in the Chalk. Late summer levels are close to average for the Lincs Limestone also and remain within the normal range for most index wells in the Permo-Triassic Triassic sandstones (albeit with significant geographical variations). The main benefit of the abundant August rainfall (given normal autumn rainfall) is likely to be an earlier than usual onset of the seasonal recovery of recharge rates.

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

Rainfall accumulations and return period estimates

Area	Rainfall	Aug 2004	Jun 04-Aug 04	RP	Jan 04-Aug 04	RP	Sep 03-Aug 04	RP	Feb 03-Aug 04	RP
England & Wales	**mm**	**151**	**283**		**644**		**963**		**1314**	
	%	**196**	**138**	**10-20**	**115**	**5-10**	**106**	**2-5**	**95**	**2-5**
North West	mm	**251**	423		871		1282		1775	
	%	**229**	152	30-40	121	5-15	105	2-5	98	2-5
Northumbrian	mm	**186**	341		681		942		1261	
	%	**225**	161	35-40	125	10-20	109	2-5	95	2-5
Severn Trent	mm	**141**	251		564		794		1120	
	%	**205**	136	5-15	116	5-10	103	2-5	95	2-5
Yorkshire	mm	**169**	317		670		910		1261	
	%	**223**	159	30-50	127	10-20	109	2-5	98	2-5
Anglian	mm	**132**	262		525		725		969	
	%	**238**	166	50-80	135	30-40	120	5-15	103	2-5
Thames	mm	**124**	211		506		751		991	
	%	**210**	129	5-10	115	2-5	107	2-5	92	2-5
Southern	mm	**101**	183		492		810		1072	
	%	**173**	114	2-5	105	2-5	103	2-5	92	2-5
Wessex	mm	**97**	201		536		834		1165	
	%	**143**	112	2-5	103	2-5	98	2-5	91	2-5
South West	mm	**164**	302		756		1118		1590	
	%	**190**	133	5-10	106	2-5	94	2-5	90	2-5
Welsh	mm	**164**	301		835		1272		1813	
	%	**155**	112	2-5	106	2-5	95	2-5	91	2-5
Scotland	**mm**	**190**	**391**		**988**		**1480**		**2025**	
	%	**163**	**131**	**10-20**	**116**	**5-15**	**101**	**2-5**	**93**	**2-5**
Highland	mm	**174**	407		1171		1768		2408	
	%	**134**	121	5-10	118	5-15	102	2-5	95	2-5
North East	mm	**155**	329		744		1065		1402	
	%	**171**	139	10-20	118	10-20	103	2-5	90	5-10
Tay	mm	**253**	426		895		1259		1745	
	%	**254**	165	60-90	116	5-10	98	2-5	91	2-5
Forth	mm	**182**	360		779		1119		1559	
	%	**186**	146	20-35	114	5-10	98	2-5	91	5-10
Tweed	mm	**199**	372		771		1088		1446	
	%	**222**	160	50-80	125	10-20	108	2-5	95	2-5
Solway	mm	**229**	400		955		1444		2004	
	%	**188**	134	5-15	114	5-10	101	2-5	94	2-5
Clyde	mm	**223**	458		1147		1752		2426	
	%	**157**	130	5-15	115	5-10	100	<2	95	2-5
Northern Ireland	**mm**	**105**	**276**		**670**		**1000**		**1499**	
	%	**110**	**115**	**2-5**	**101**	**2-5**	**91**	**2-5**	**91**	**2-5**

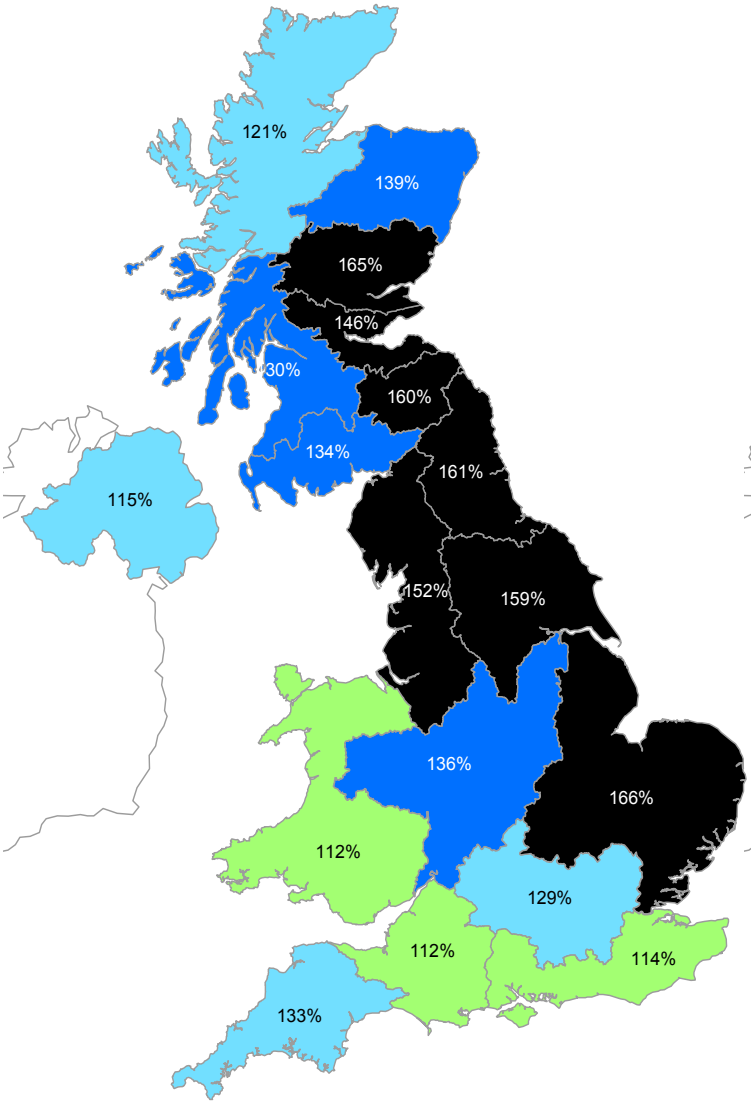
% = percentage of 1961-90 average *RP = Return period*

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 March 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.

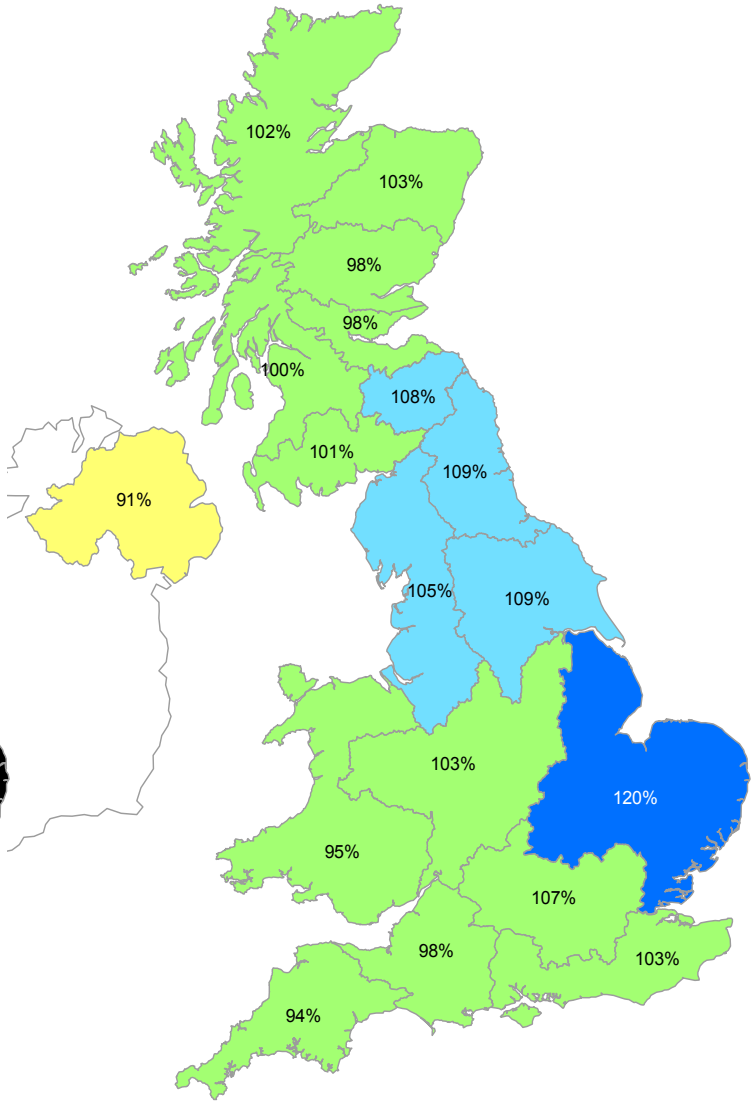
Rainfall . . . Rainfall . .

Key

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



June 2004 - August 2004

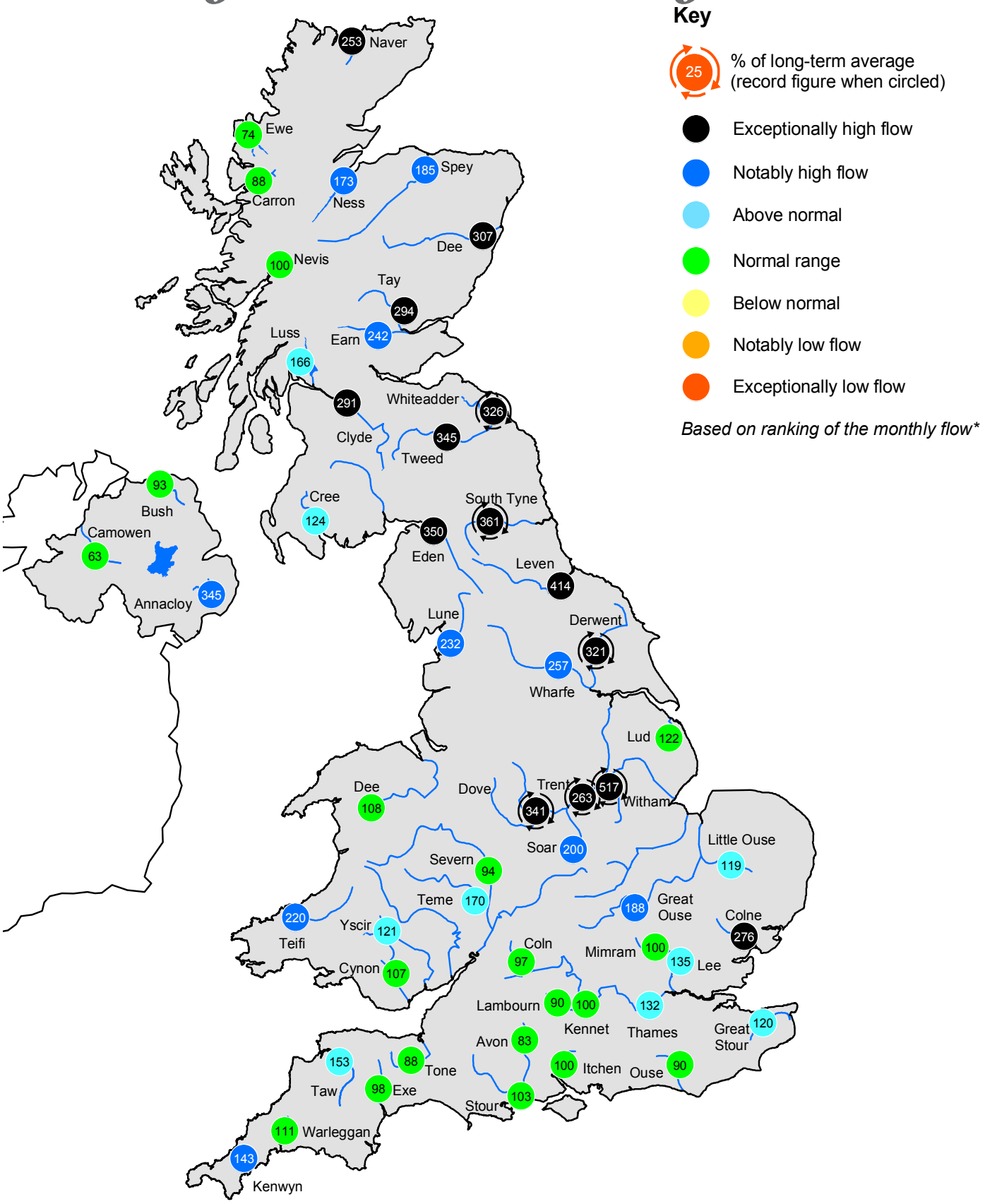


September 2003 - August 2004

Rainfall accumulation maps

Regional rainfall totals for the summer were notably high in most regions - contributing to the second wettest June-August period since 1958 for the UK as a whole. Rainfall totals over the last 12 months are much closer to normal with modest rainfall deficiencies characterising a few regions.

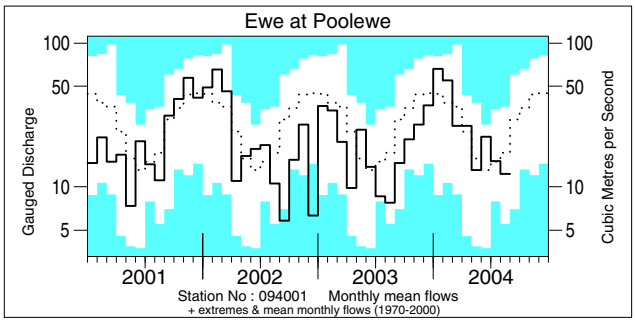
River flow . . . River flow . . .

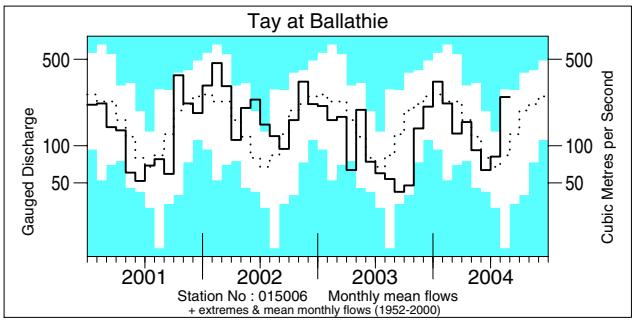


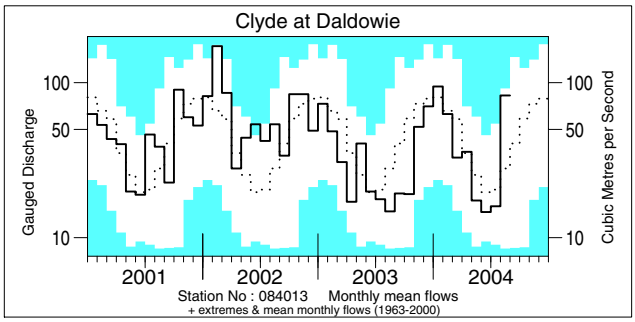
River flows - August 2004

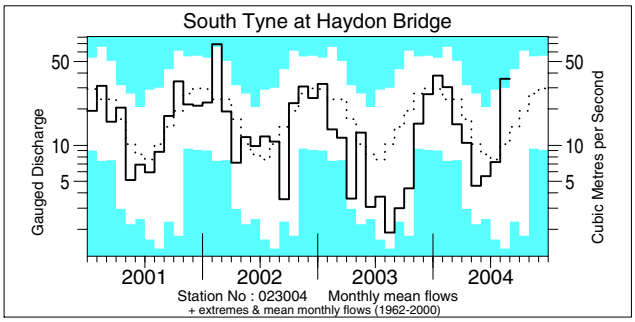
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

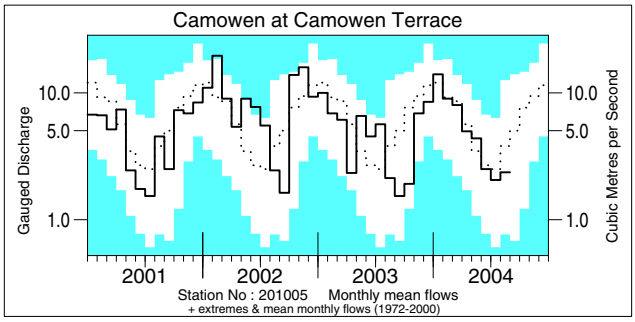
River flow . . . River flow . . .

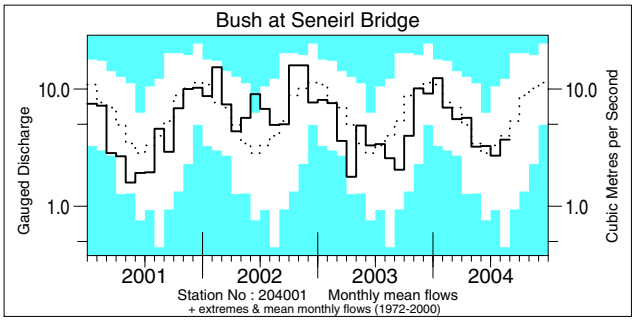


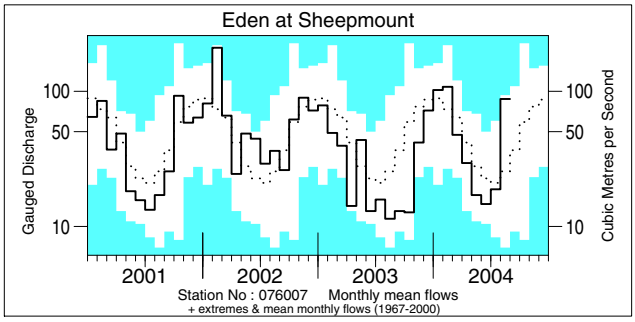


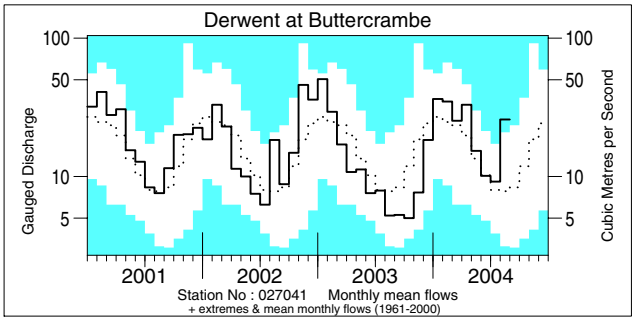


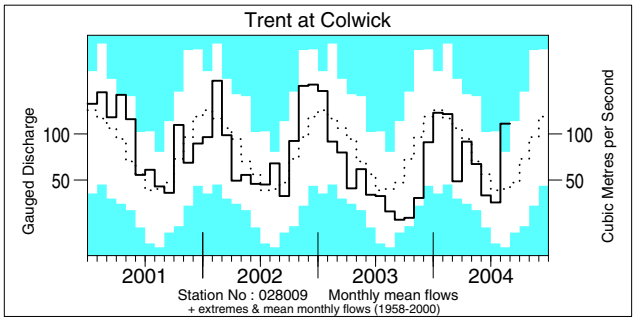


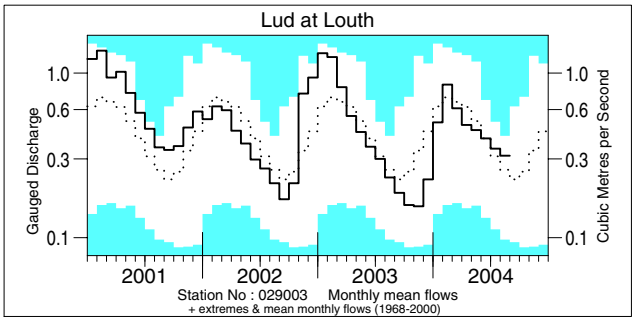








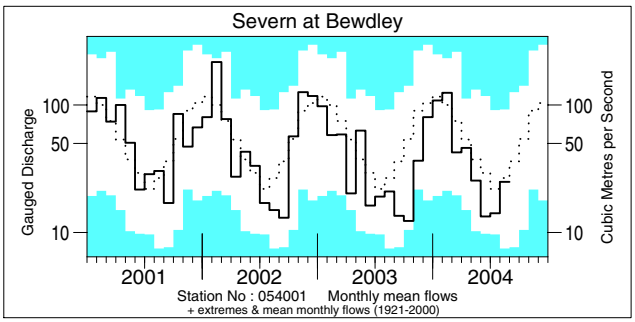


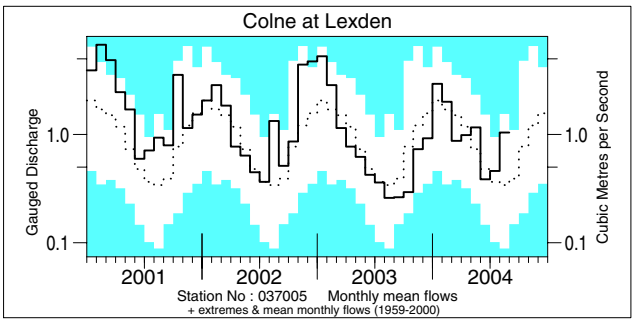


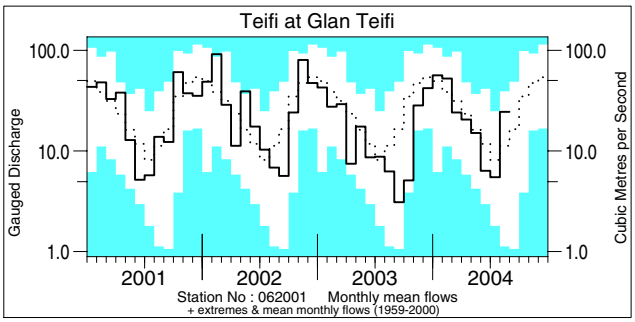
Monthly river flow hydrographs

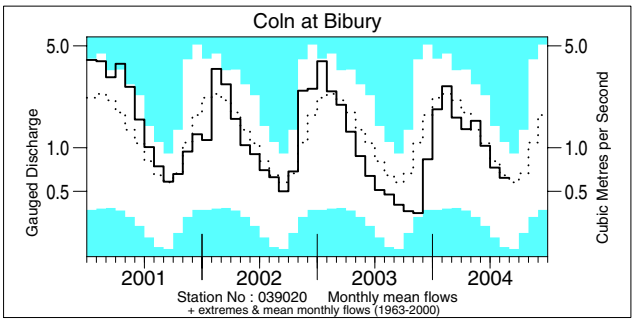
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2001 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

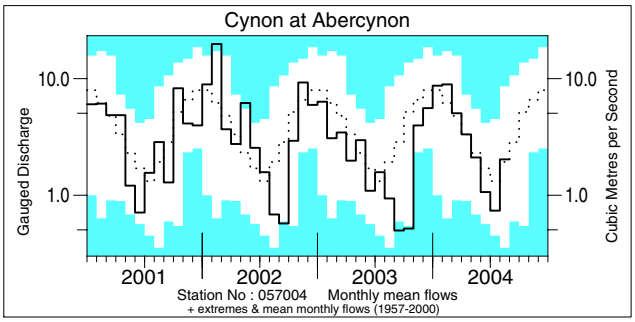
River flow . . . River flow . . .

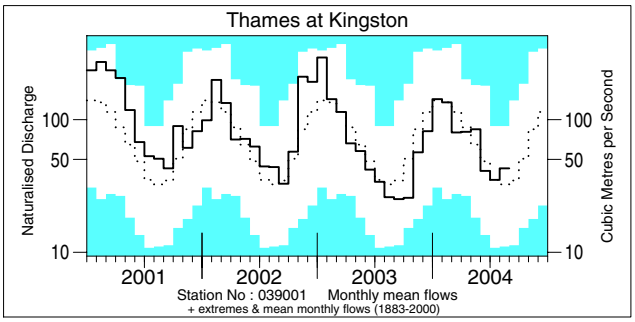


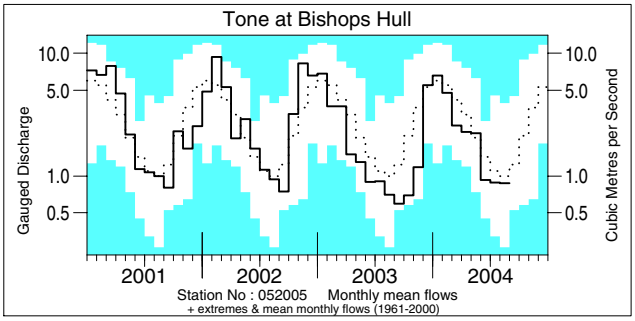


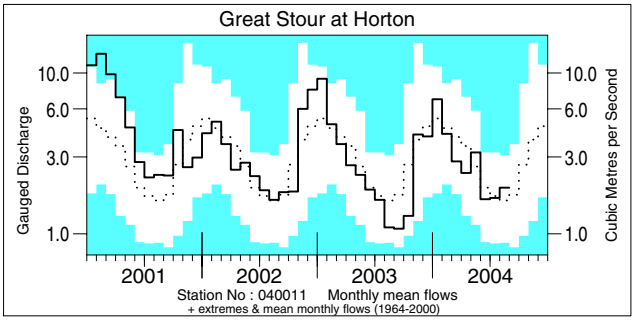


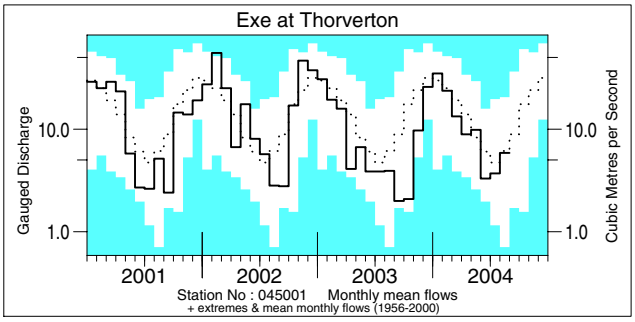


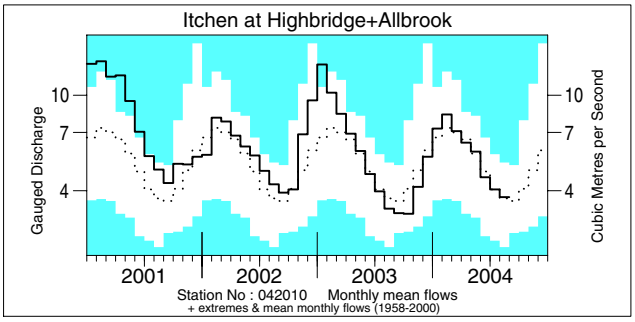












Notable runoff accumulations **(a) June 2004 - August 2004, (b) September 2003 - August 2004, (c) February 2003- August 2004**

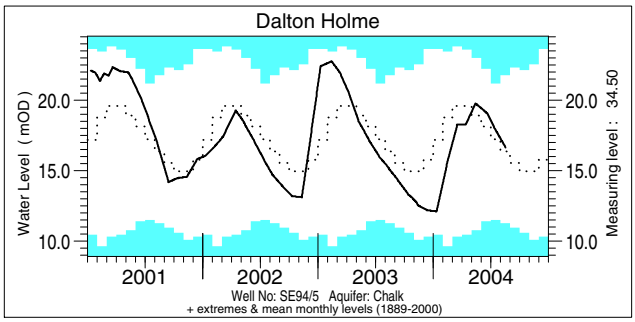
	River	%lta	Rank
a)	Dee (Park)	150	30/32
	Tay	165	50/52
	Derwent (Yorks)	170	43/43
	Dover Beck	193	30/30
	Witham	246	45/46
	Eden	174	35/37
	Naver	207	27/27

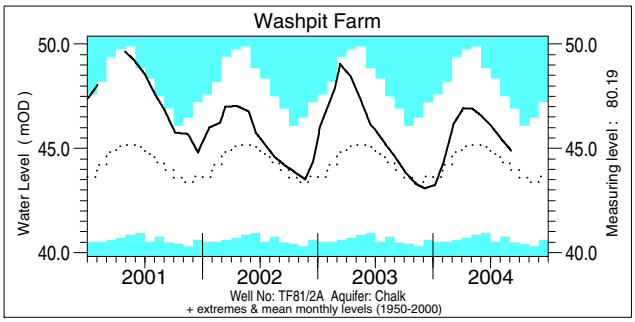
	River	%lta	Rank
b)	Dee (Park)	79	4/31
	Earn	81	6/56
	Forth	69	1/23
	Soar	66	5/33
	Taw	66	3/45
	Mourne	79	1/22
	Faughan	72	1/28

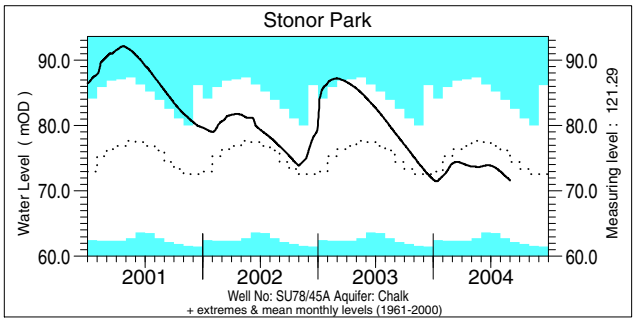
	River	%lta	Rank
c)	Dee (Woodend)	79	5/74
	Tweed (Norham)	80	4/44
	Medway	57	3/39
	Exe	73	2/47
	Wye	72	4/67
	Luss	77	1/24
	Annacloy	72	1/24

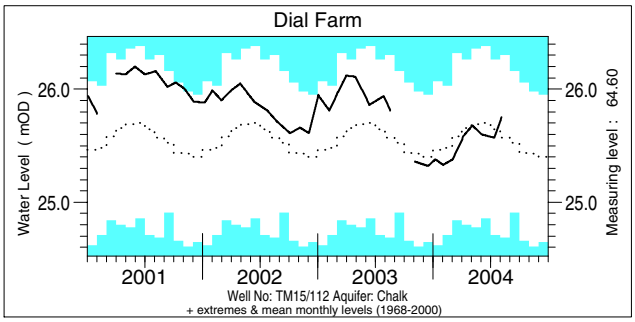
lta = long term average
Rank 1 = lowest on record

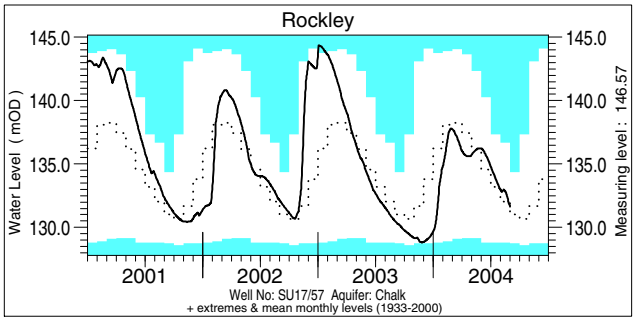
Groundwater . . . Groundwater

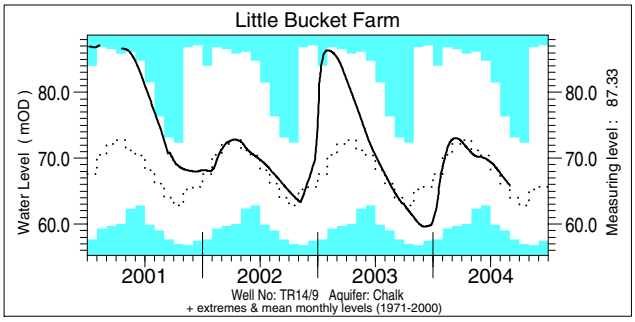


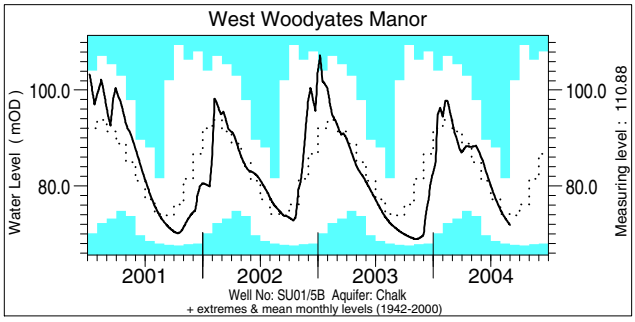


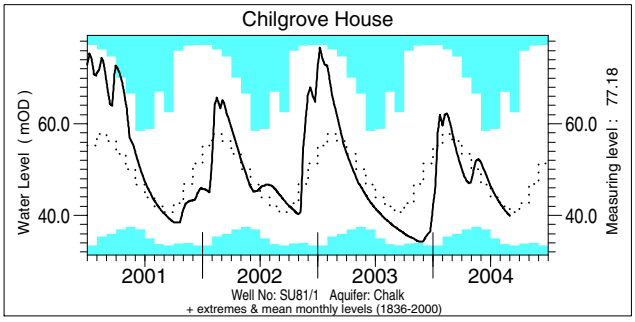


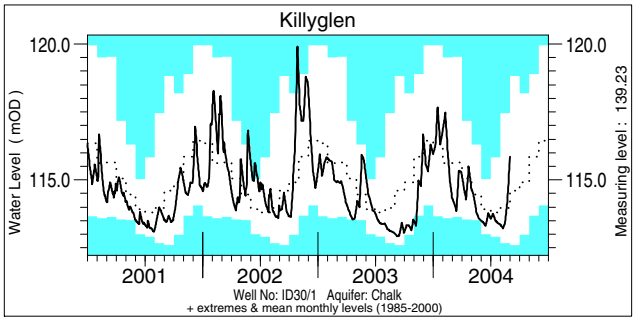


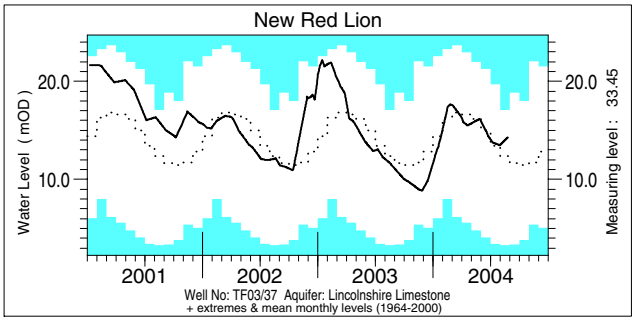






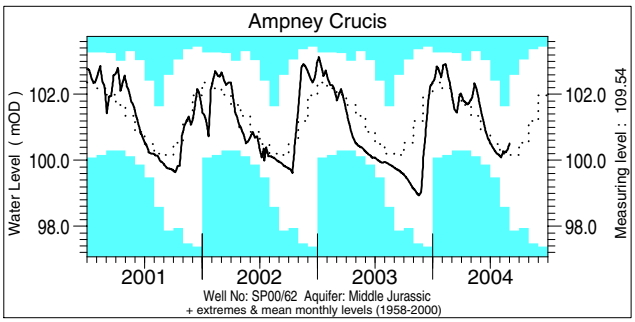


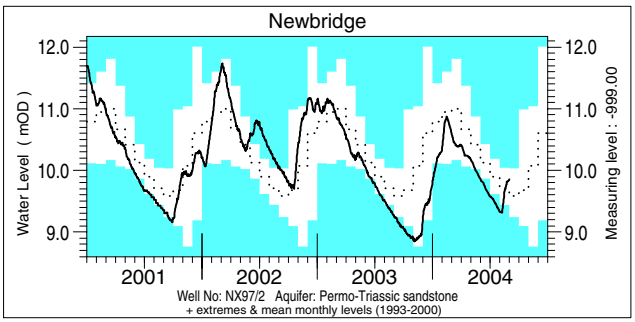


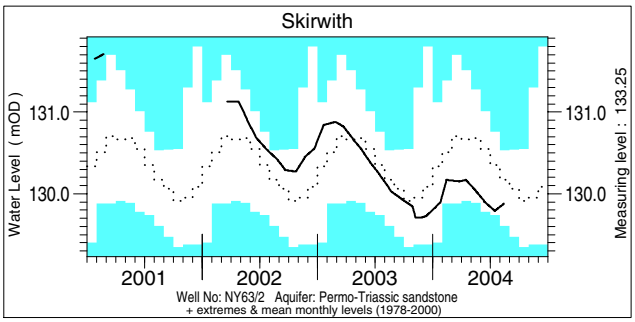


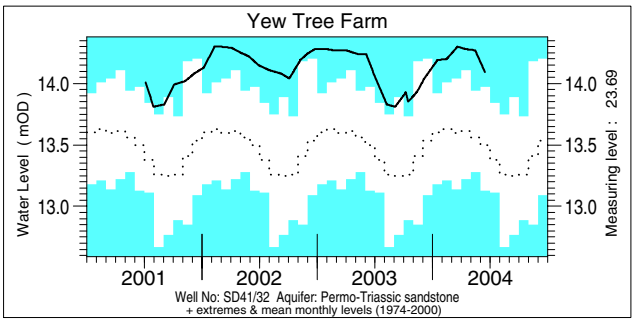
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

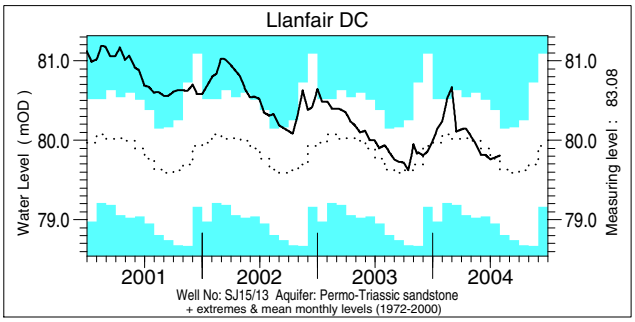
Groundwater . . . Groundwater

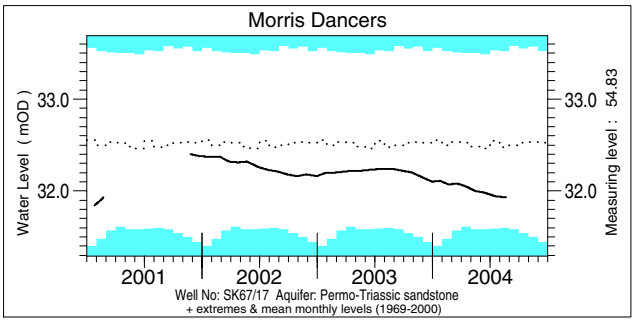


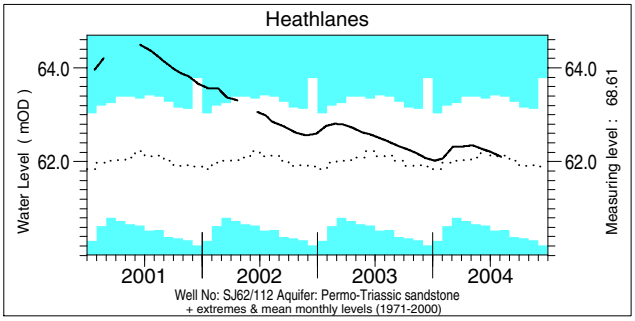


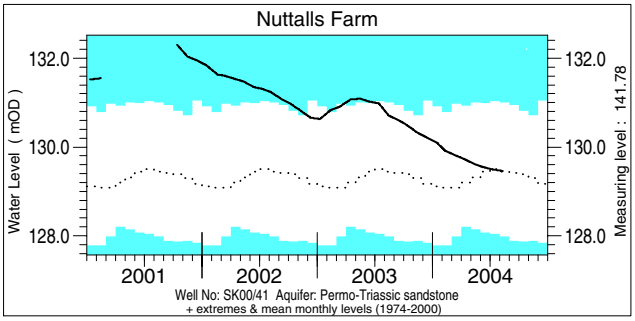


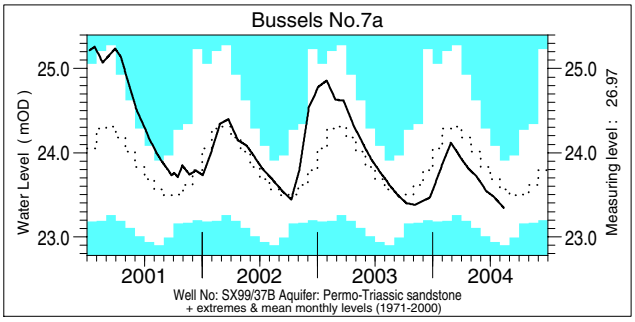


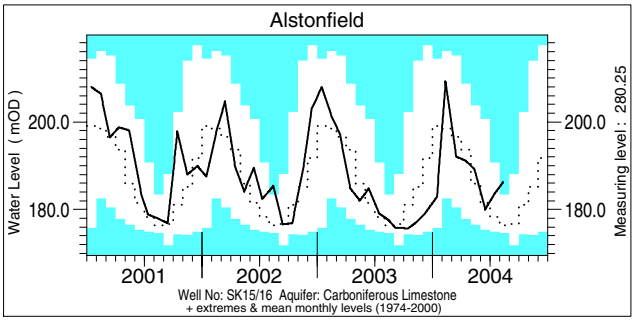












Groundwater levels August / September 2004

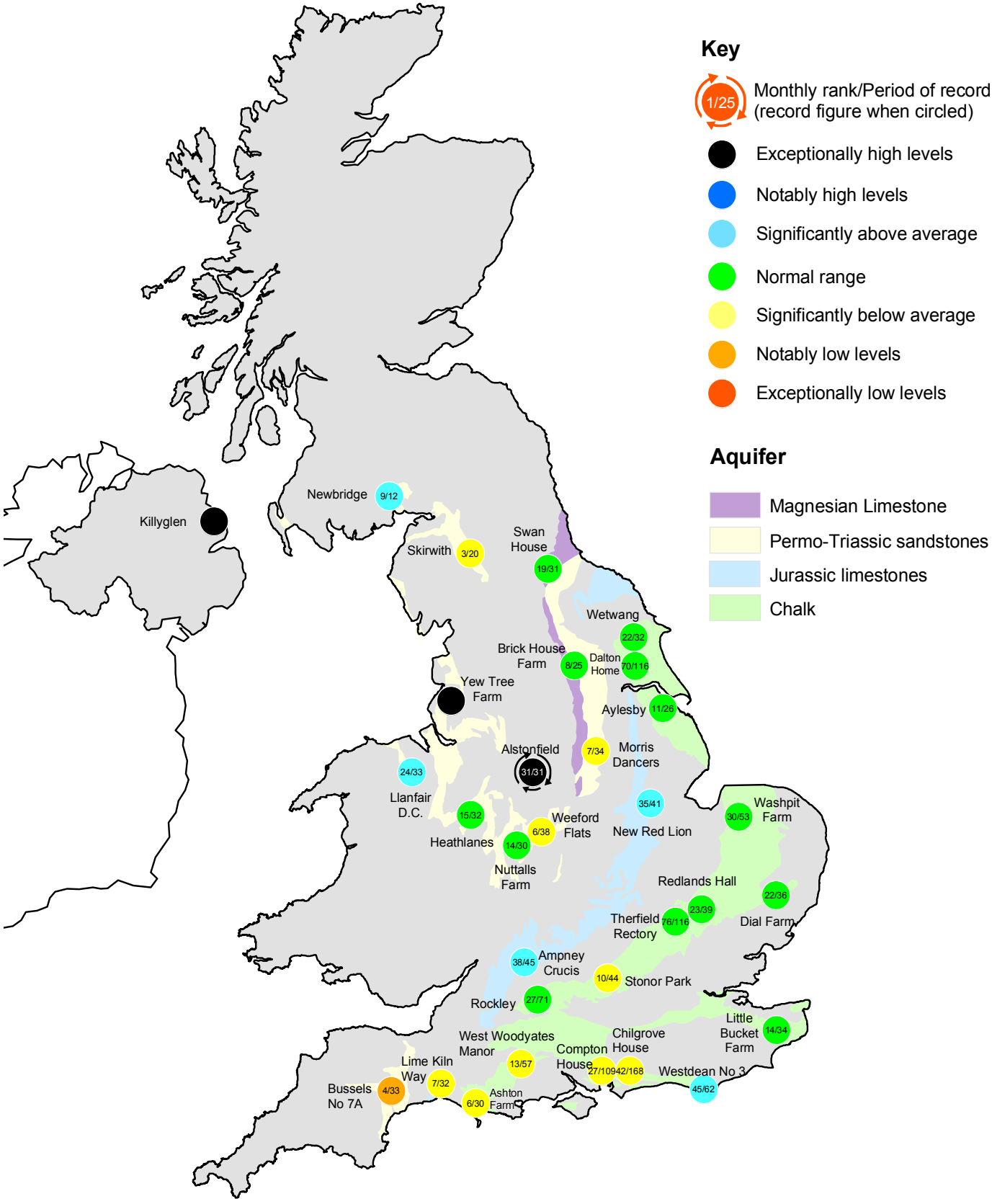
Borehole	Level	Date	Aug. av.
Dalton Holme	16.64	16/08	16.25
Washpit Farm	44.89	04/09	44.48
Stonor Park	71.56	01/09	76.32
Dial Farm	25.75	04/08	25.59
Rockley	131.61	01/09	132.02
Little Bucket Farm	65.82	31/08	67.10
West Woodyates	71.85	31/08	73.96

Borehole	Level	Date	Aug. av.
Chilgrove House	39.88	31/08	41.74
Killyglen	115.86	31/08	113.83
New Red Lion	14.30	24/08	12.37
Ampney Crucis	100.52	01/09	100.16
Newbridge	9.85	31/08	9.70
Skirwith	129.88	13/08	130.17
Yew Tree Farm	14.09	14/06	13.36

Borehole	Level	Date	Aug. av.
Llanfair DC	79.81	01/08	79.62
Morris Dancers	31.93	20/08	32.37
Heathlanes	62.10	05/08	62.16
Nuttalls Farm	129.46	10/08	129.64
Bussels No.7a	23.34	13/08	23.60
Alstonfield	186.28	11/08	177.16

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



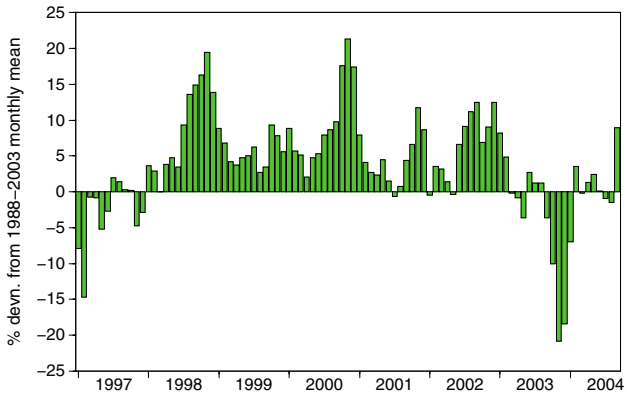
Groundwater levels - August 2004

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.

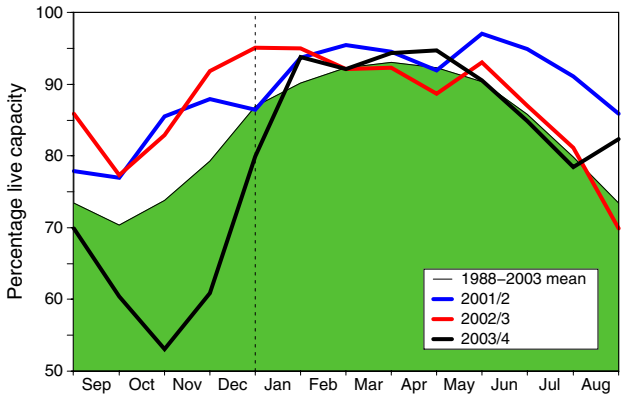
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

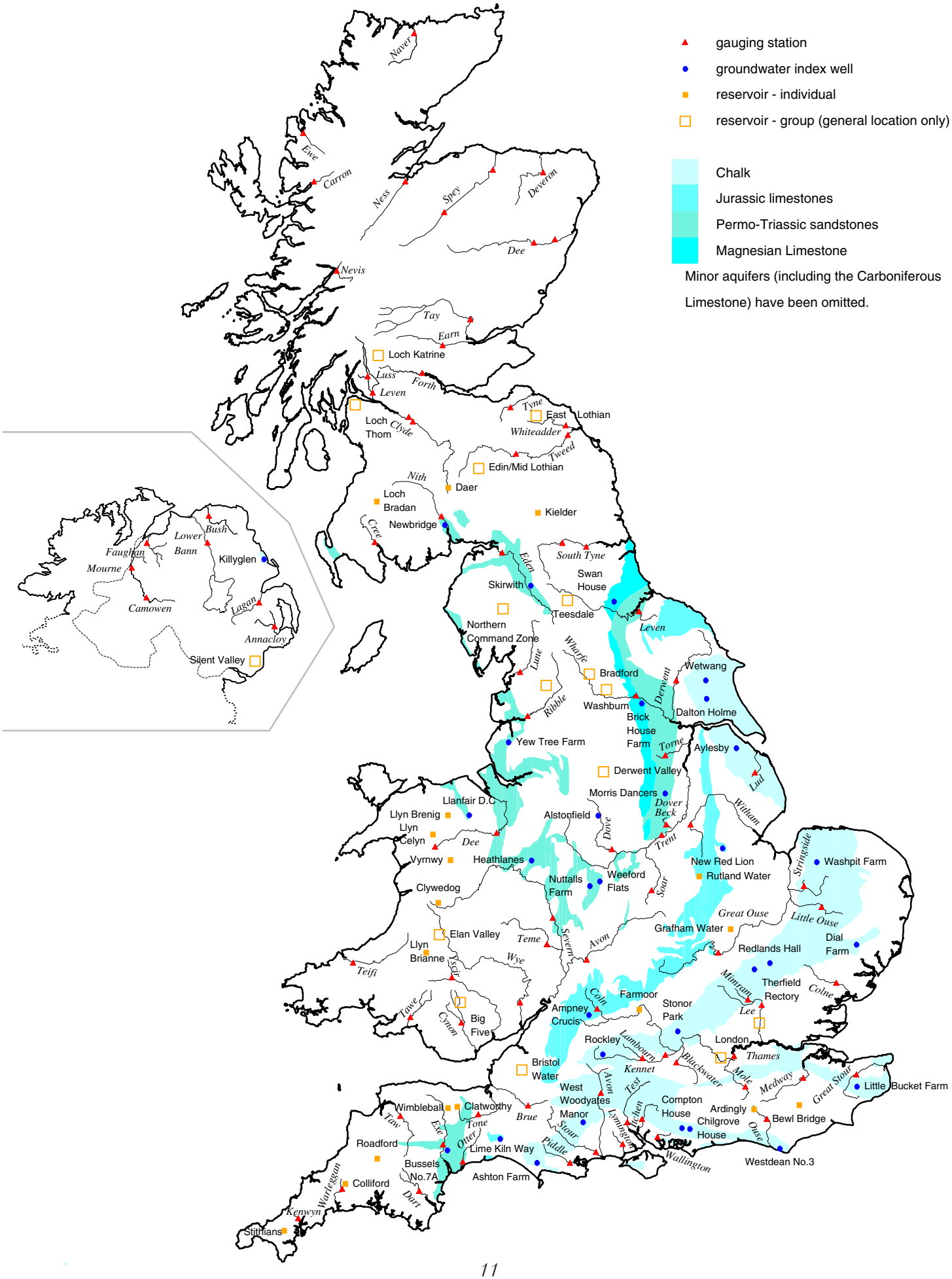
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2004 May	Jun	Jul	Aug	Sep	Avg. Sep	Min. Sep	Year* of min.
North West	N Command Zone	• 124929	89	76	63	55	**73**	53	24	1995
	Vyrnwy	55146	95	88	73	68	**67**	69	36	1995
Northumbrian	Teesdale	• 87936	95	83	79	68	**97**	61	38	1995
	Kielder	(199175)	(92)	(91)	(94)	(89)	**(94)**	(86)	(66)	1989
Severn Trent	Clywedog	44922	100	100	97	94	**92**	74	38	1989
	Derwent Valley	• 39525	100	92	91	83	**98**	63	34	1995
Yorkshire	Washburn	• 22035	95	89	84	79	**95**	64	34	1995
	Bradford supply	• 41407	93	85	75	67	**90**	61	21	1995
Anglian	Grafham	(55490)	(98)	(95)	(95)	(84)	**(76)**	(85)	(59)	1997
	Rutland	(116580)	(97)	(95)	(91)	(90)	**(87)**	(81)	(66)	1995
Thames	London	• 202340	97	94	89	84	**84**	79	62	1995
	Farmoor	• 13830	100	99	97	99	**98**	91	64	1995
Southern	Bewl	28170	100	99	92	87	**81**	69	38	1990
	Ardingly	4685	100	100	89	82	**71**	72	47	1996
Wessex	Clatworthy	5364	100	96	86	77	**64**	60	31	1995
	Bristol WW	• (38666)	(92)	(89)	(81)	(75)	**(66)**	(65)	(43)	1990
South West	Colliford	28540	75	73	67	60	**55**	72	43	1997
	Roadford	34500	68	67	62	56	**51**	74	40	1995
	Wimbleball	21320	100	97	87	79	**69**	67	40	1995
	Stithians	5205	94	88	78	68	**57**	59	30	1990
Welsh	Celyn and Brenig	• 131155	99	97	88	83	**82**	79	49	1989
	Brianne	62140	99	96	88	81	**85**	84	55	1995
	Big Five	• 69762	99	93	82	68	**71**	67	29	1995
	Elan Valley	• 99106	95	93	87	79	**81**	75	46	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	81	78	74	69	**80**	75	45	1998
	East Lothian	• 10206	100	98	100	97	**100**	80	63	1989
Scotland(W)	Loch Katrine	• 111363	93	84	74	66	**74**	67	50	2000
	Daer	22412	97	89	75	65	**90**	67	41	1995
	Loch Thom	• 11840	97	92	88	93	**100**	73	58	1997
Northern Ireland	Total+	•	84	74	72	62	**72**	72	40	1995
	Silent Valley	• 20634	64	58	56	48	**58**	62	33	2000

() 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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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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