Hydrological Summary
for the United Kingdom

October 2005

General

October was an exceptionally warm and, after the first week, notably unsettled month. Successive pulses of frontal rainfall and, latterly, saturated catchment conditions saw the focus of hydrological concern swing decisively towards the risk of flooding across much of the UK. Exceptional peak flows were reported for a number of western and northern rivers with notable runoff rates extending well into November. These served to accentuate regional contrasts in water resources status. Very brisk increases in major reservoir stocks (e.g. > 30% at Elan Valley in three weeks) helped ensure that overall stocks for England and Wales were appreciably above average by early November. However, October levels in some south-eastern reservoirs remained exceptionally low (the lowest for October at Weir Wood since its construction in 1953) and groundwater levels were very depressed in some southern Chalk outcrops. Correspondingly, flows in many spring-fed rivers continued to decline. October flows approached the lowest on record in a number of Chalk catchments and accumulated runoff totals (over 12 months) remain exceptionally low over much of southern Britain. The recent notably wet episode has left most impermeable catchments across the UK very vulnerable to further rainfall. In the drought affected areas, it has provided a platform (only) for a seasonal recovery in runoff and recharge rates; above average rainfall will still be needed throughout the coming winter to provide a healthy water resources outlook for 2006.

Rainfall

In much of the UK, the dry early autumn weather continued into October; some central southern areas of England reported less than 5mm of rain over the first 11 days. Thereafter, a sequence of vigorous frontal systems, many on a south-westerly airflow, produced notable rainfall totals over the following four weeks. The 9-12th was an especially wet interlude; 24-hr rainfall totals included 98.6mm at Braidlie in the Borders (91mm at Carlisle) and 114mm at Milford Haven on the 11th; the 24th was also very wet over wide areas. Most low pressure systems tracked to the south of northern Scotland where some areas (e.g. much of Sutherland) reported <50% of the October average rainfall. By contrast, the Borders were exceptionally wet – up to 250% – and totals across most of England and Wales exceeded 120%; Northern Ireland was wet also. For E&W it was the wettest month, by a substantial margin, since October 2004 but, significantly, the most modest positive anomalies tended to characterise those areas where the drought is most entrenched; a few areas of Kent failed to reach the October average. In most regions, rainfall over the last 6 months has been in the normal range but very substantial deficits remain in the 12-month timeframe. For E&W, it was the 4th driest Nov-Oct since 1975/76 but for parts of the South East (and central southern England), where deficiencies are 25% or more, a similar ranking applies over the last 70 years.

Flows

October runoff totals for many index catchments were within the normal range but the considerable spatial and temporal variations which typify autumn river flows were heavily accentuated this October. Modest autumn flows were common during the first week but in most responsive catchments rapid recoveries began around the 10th, heralding significant flooding in many areas. On the 11th, the Teviot, at Hawick, exceeded its previous maximum flow (established in January this year) in a 42-yr record; around 200 properties were flooded. In Wales, Haverfordwest was flooded as the Western Cleddau recorded its highest level in 40-yr record. More localised flooding was also common as rainfall intensities exceeded urban drainage capacities (e.g. in Carlisle) or soil infiltration capacities (e.g. surface runoff inundated vulnerable settlements near St Austell in Cornwall). Traffic disruption was severe and Flood Warnings were widespread, continuing into November. Some notable spates occurred in impermeable lowland catchments (e.g. on the Wey) but the depressed flows in many spring-fed rivers were of greater significance. Following 29 successive months with below average monthly flows, the Lambourn closely approached its early October minima (in a record from 1962). In such rivers, accumulated runoff totals testify to the drought's severity. The Aug-Oct runoff total for the Test vies with 1997 as the lowest in a series from 1957 and runoff over the last 12 months is among the lowest three on record for many catchments in eastern, central and southern England (parts of Northern Ireland also).

Groundwater

October rainfall totals were appreciably above average across most aquifer outcrop areas but in the east and south substantial soil moisture deficits initially limited its effectiveness. The rainfall distribution favoured the more westerly and northerly aquifers but, as elsewhere, depressed groundwater levels, and the associated depth of the unsaturated zone, mitigated against a rapid response to the heavy rainfall from mid-month. Some signs of a seasonal recovery are evident (e.g. in the Carboniferous Limestone) but, generally, mid-October levels underlined the exceptional depletion in groundwater resources over the last two years. In the Permo-Triassic sandstones at Morris Dancers and Bussels groundwater levels closely approached their lowest October levels on record; for the latter it was the lowest level for any month since 1992. In the Chalk, levels at Chilgrove were around 40m below their early 2003 peak and the mean October level eclipsed 1976 as the lowest in a series from 1836 (but levels began to recover by month end). Levels are less depressed, but still well below average, throughout much of the Chalk outcrops of southern England. The Oct/early Nov rainfall has initiated the 2005/06 recharge season in most areas but further sustained rainfall will be needed to restore groundwater levels to within the normal winter range.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

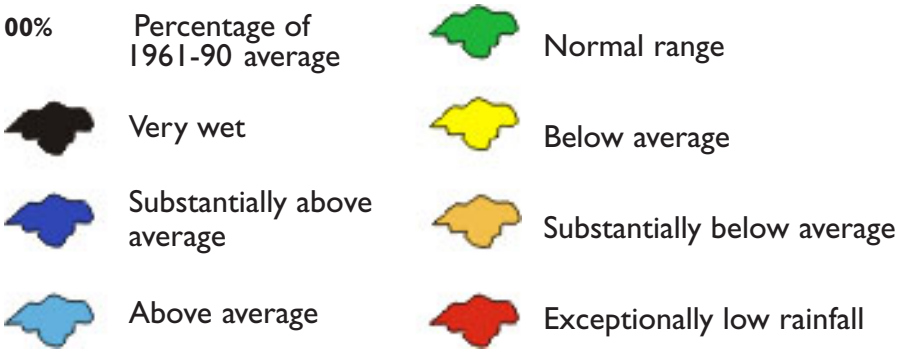
Rainfall accumulations and return period estimates

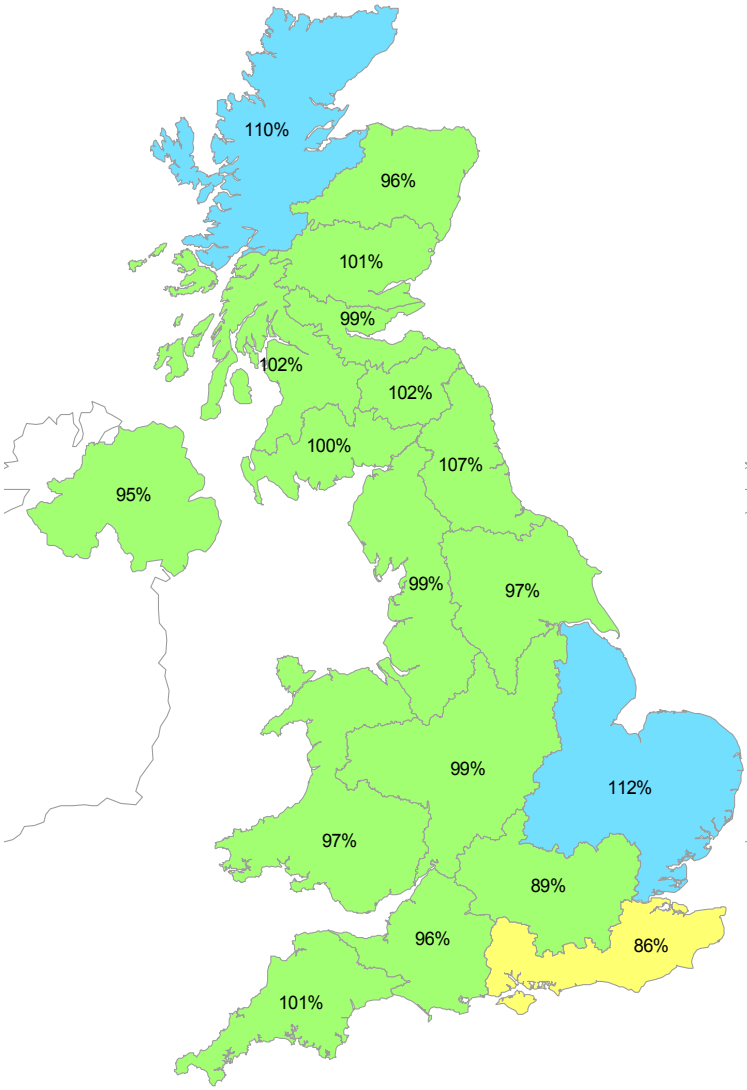
Area	Rainfall	Oct 2005	Aug 05-Oct 05	RP	May 05-Oct 05	RP	Feb 05-Oct 05	RP	Nov 04-Oct 05	RP
England & Wales	**mm**	**120**	**250**		**426**		**604**		**789**	
	%	**138**	**103**	**2-5**	**98**	**2-5**	**95**	**2-5**	**86**	**5-10**
North West	mm	**191**	386		596		827		1177	
	%	**149**	109	2-5	99	2-5	98	2-5	97	2-5
Northumbrian	mm	**131**	263		454		695		885	
	%	**171**	113	2-5	107	2-5	113	2-5	102	2-5
Severn Trent	mm	**101**	209		370		526		652	
	%	**153**	105	2-5	99	2-5	96	2-5	85	5-10
Yorkshire	mm	**97**	227		392		584		739	
	%	**130**	103	2-5	97	2-5	99	2-5	89	2-5
Anglian	mm	**65**	195		344		456		552	
	%	**128**	124	5-10	112	2-5	104	2-5	91	2-5
Thames	mm	**83**	184		308		428		544	
	%	**129**	100	2-5	89	2-5	86	2-5	78	10-20
Southern	mm	**96**	194		315		441		578	
	%	**119**	93	2-5	86	2-5	82	5-10	74	20-35
Wessex	mm	**121**	205		380		534		699	
	%	**149**	92	2-5	96	2-5	91	2-5	82	5-10
South West	mm	**171**	295		516		730		995	
	%	**146**	99	2-5	101	2-5	93	2-5	83	5-10
Welsh	mm	**202**	366		588		846		1175	
	%	**146**	101	2-5	97	2-5	94	2-5	87	5-10
Scotland	**mm**	**181**	**459**		**723**		**1068**		**1621**	
	%	**113**	**109**	**2-5**	**105**	**2-5**	**107**	**2-5**	**110**	**5-10**
Highland	mm	**175**	571		872		1307		2106	
	%	**91**	117	2-5	110	2-5	112	5-10	121	25-40
North East	mm	**139**	275		487		732		1016	
	%	**135**	96	2-5	96	2-5	101	2-5	99	2-5
Tay	mm	**192**	371		608		923		1323	
	%	**142**	104	2-5	101	2-5	105	2-5	103	2-5
Forth	mm	**163**	317		548		828		1197	
	%	**137**	96	2-5	99	2-5	104	2-5	104	2-5
Tweed	mm	**192**	313		504		747		990	
	%	**195**	112	2-5	102	2-5	105	2-5	99	2-5
Solway	mm	**240**	442		686		976		1420	
	%	**152**	105	2-5	100	<2	99	2-5	99	2-5
Clyde	mm	**207**	544		849		1222		1886	
	%	**105**	104	2-5	102	2-5	102	2-5	108	2-5
Northern Ireland	**mm**	**134**	**298**		**500**		**728**		**1031**	
	%	**117**	**96**	**2-5**	**95**	**2-5**	**95**	**2-5**	**94**	**2-5**

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

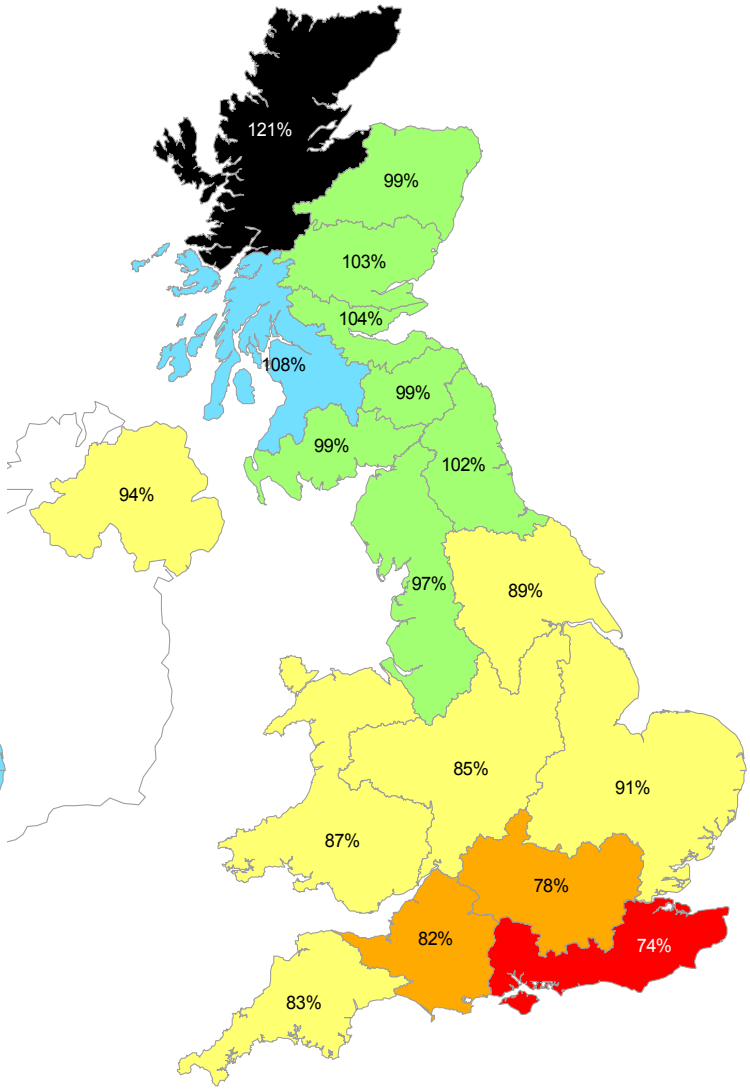
The monthly rainfall figures* provided by the Met Office (National Climate Information Centre) are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation. **All monthly totals since May 2005 are provisional (see page 12).** 1961-2003 regional monthly totals were revised by the Met Office in 2004. 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. 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 and those for the Highland region take account of ranking positions. 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 . . .





May 2005 - October 2005

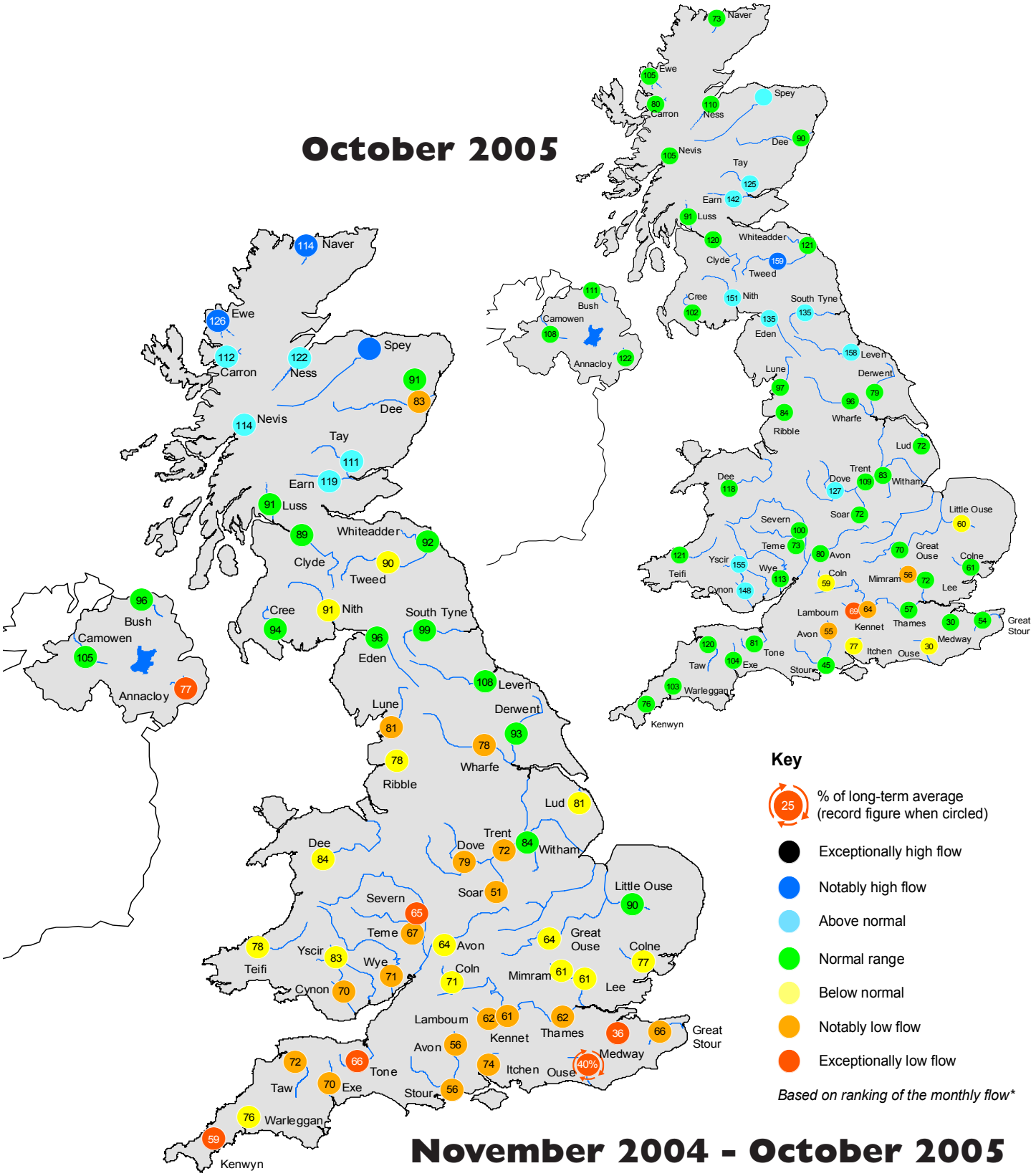


November 2004 - October 2005

Rainfall accumulation maps

Rainfall over the May-October period was within 5% of the average for England and Wales, Scotland and Northern Ireland - with significant regional anomalies confined to the north-west and south-east of Britain. This contrast is heavily emphasised in the 12-month timeframe where the focus of the drought - across southern Britain - is clearly evident.

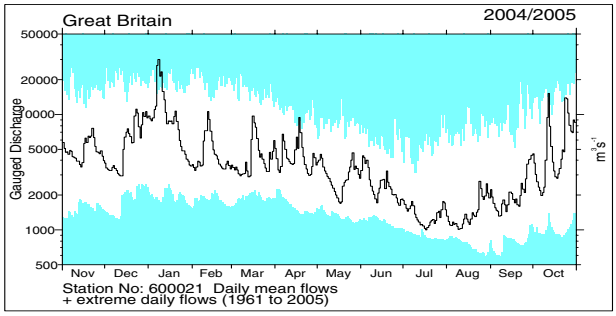
River flow . . . River flow . . .

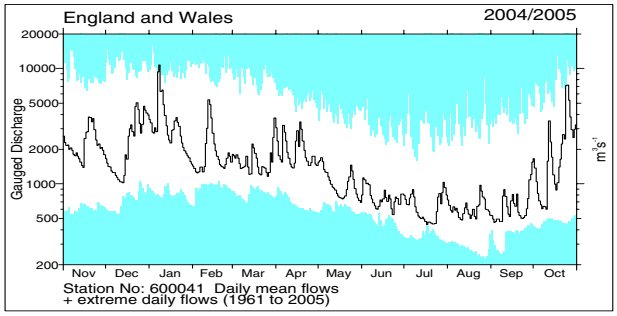


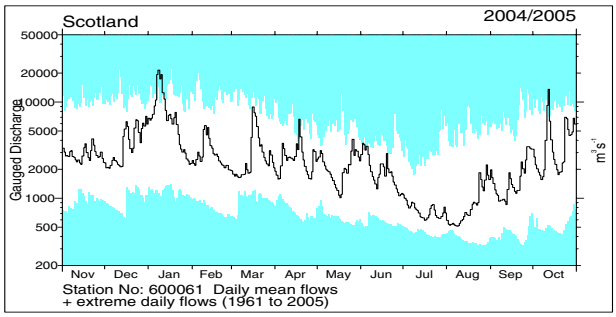
River flows

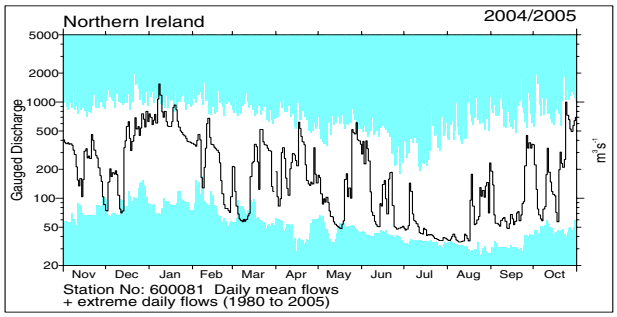
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

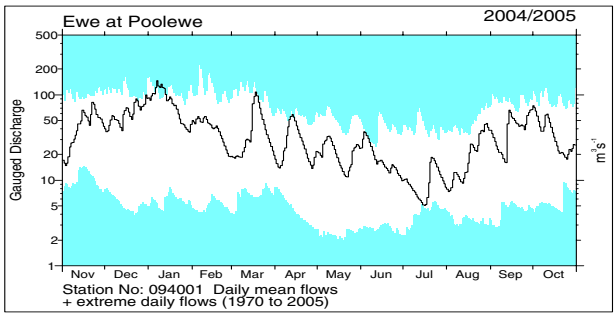
River flow . . . River flow . . .

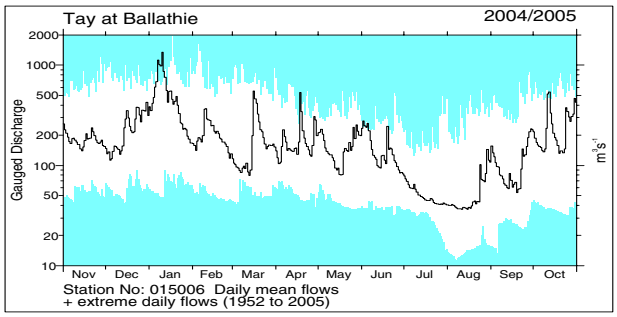


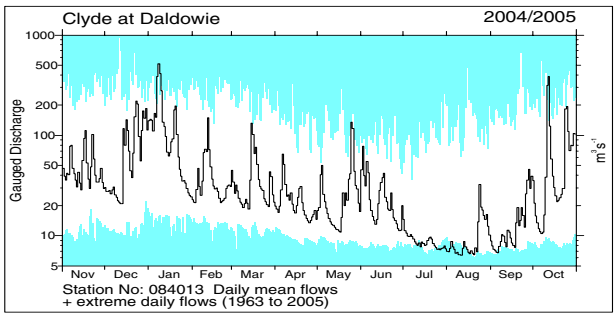


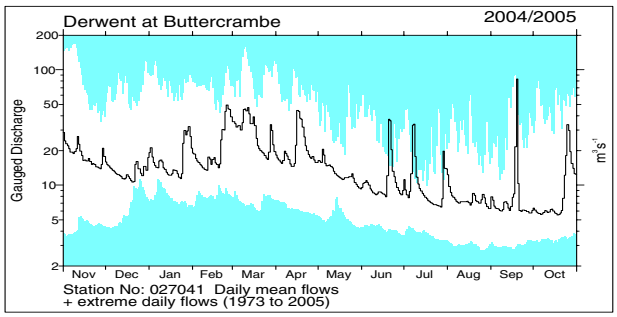


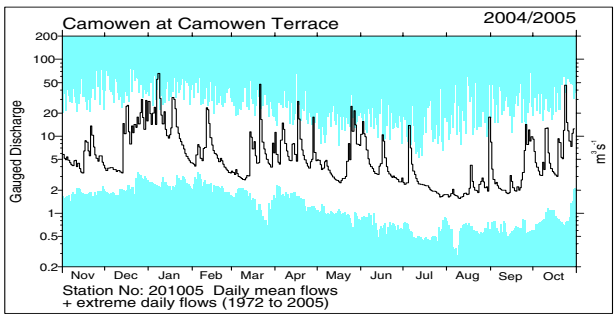


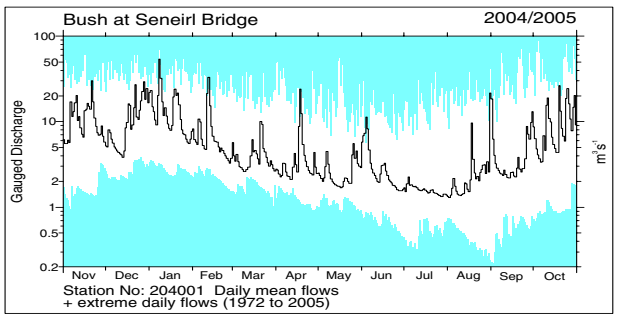








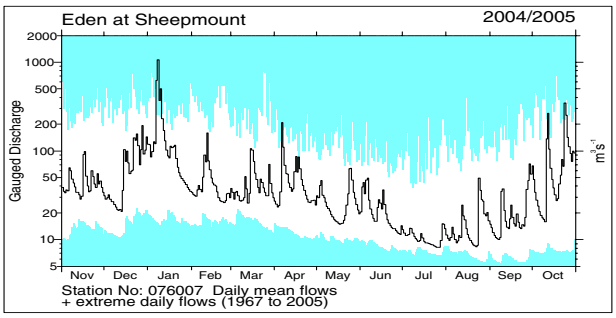


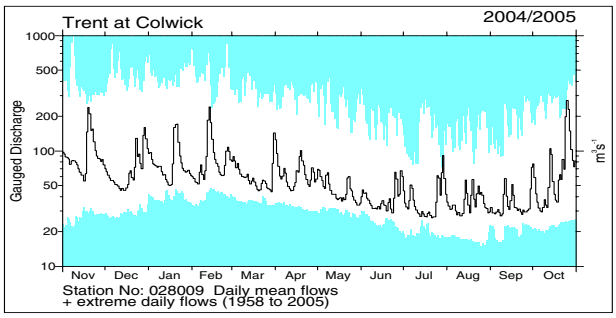


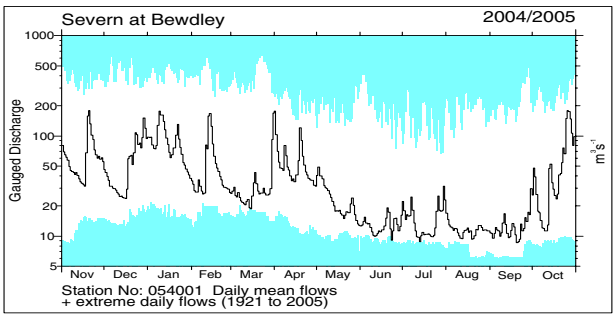
River flow hydrographs

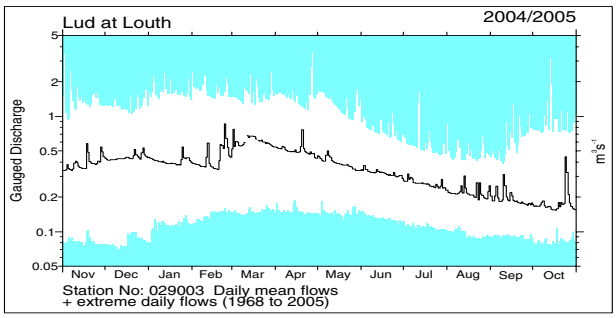
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to November 2004 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

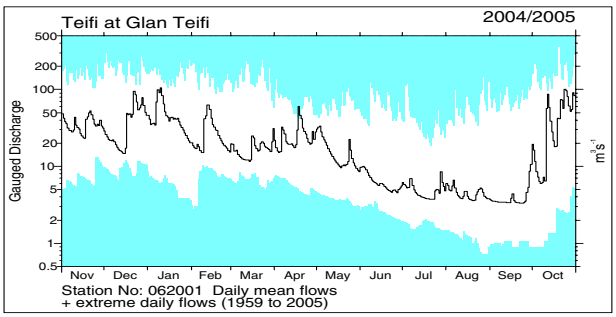
River flow . . . River flow . . .

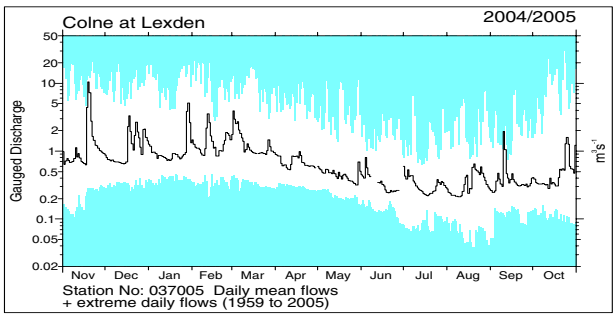


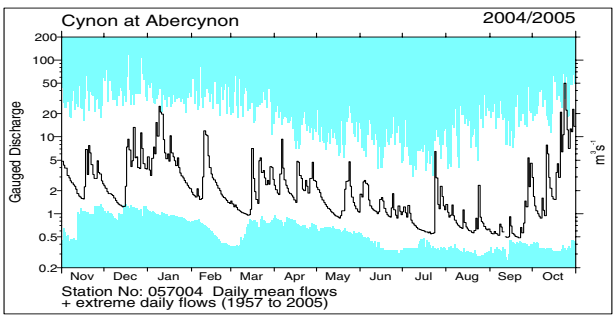


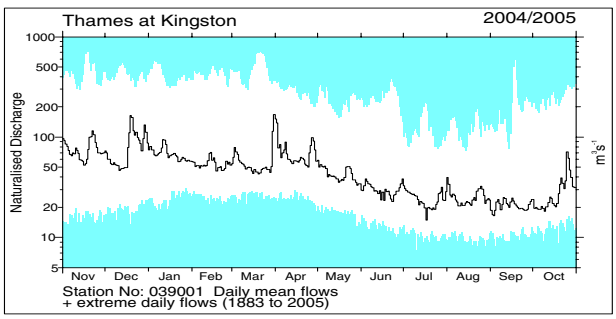


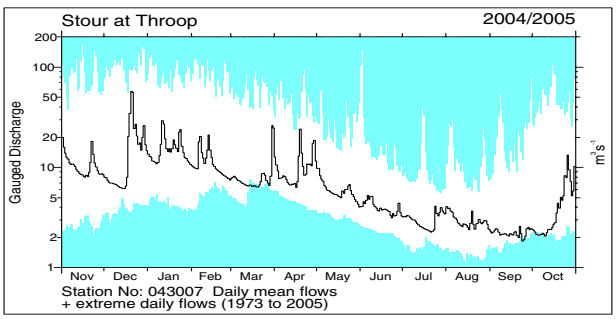


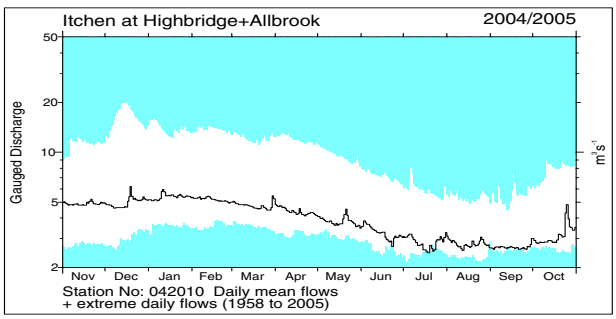












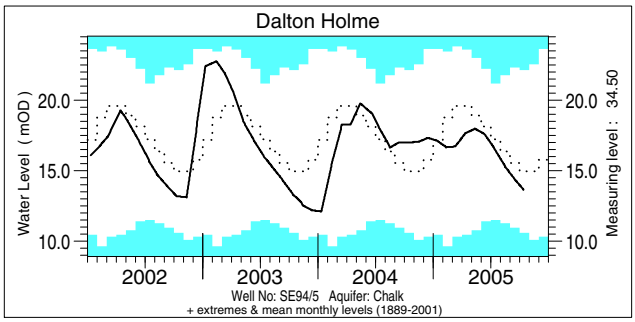
Notable runoff accumulations **(a) August 2005 - October 2005, (b) November 2004 - October 2005**

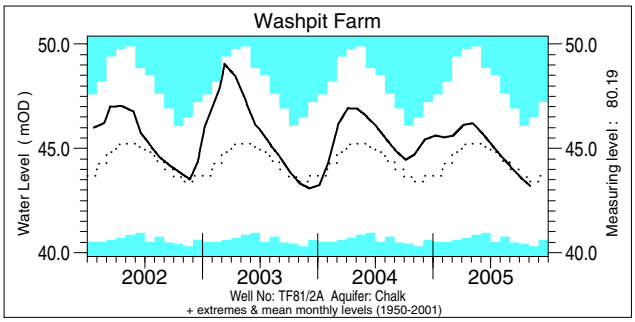
	River	%lta	Rank
a)	Mimram	53	4/53
	Kennet	67	5/44
	Lambourn	67	4/43
	Coln	69	6/42
	Test	67	1/48
	Itchen	76	3/47
	Avon (Amesbury)	60	=4/41

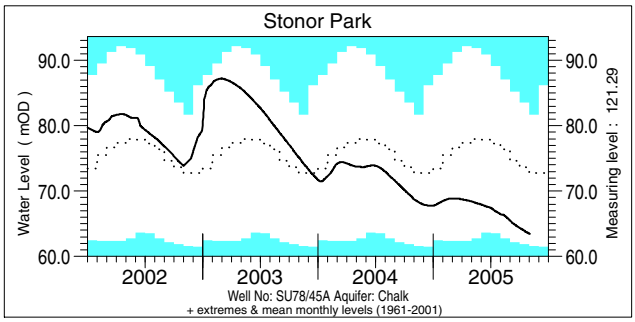
	River	%lta	Rank
b)	Soar	51	3/34
	Mole	54	1/29
	Medway	36	2/42
	Ouse (Gold Bridge)	40	1/41
	Wallington	42	3/49
	Stour (Throop)	56	3/32
	Piddle	60	2/41
	Otter	64	2/43
	Kenwyn	59	2/37
	Ewe	126	32/35
	Naver	114	25/28
	Faughan	77	2/29
	L Bann	75	1/25
	Annacloy	77	2/25

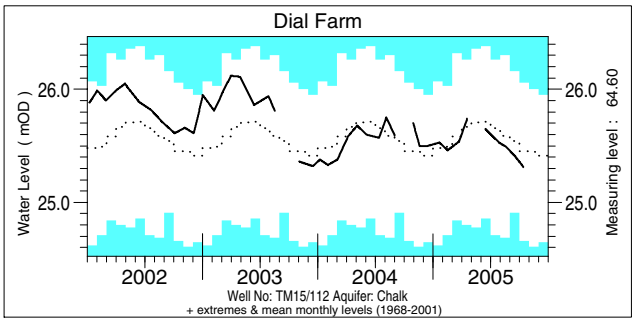
lta = long term average
Rank 1 = lowest on record

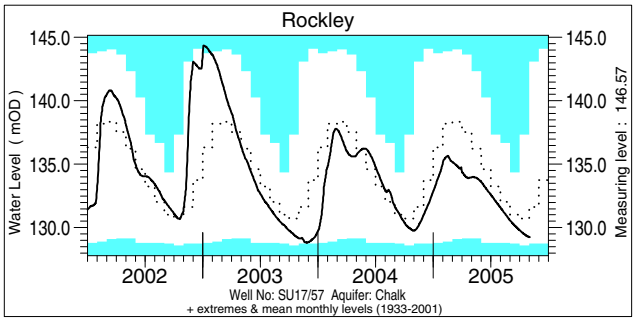
Groundwater . . . Groundwater

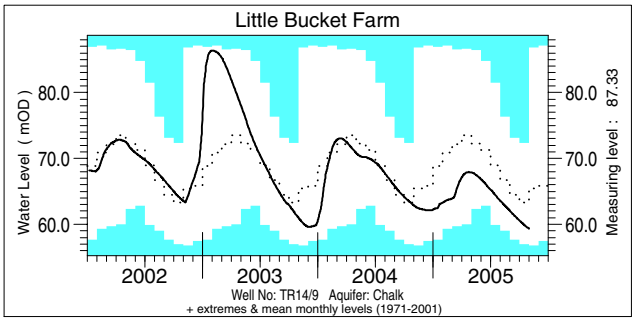


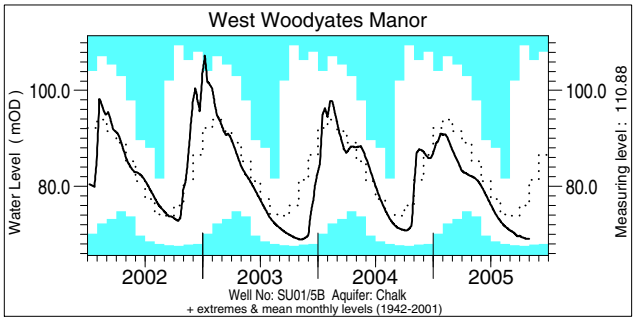


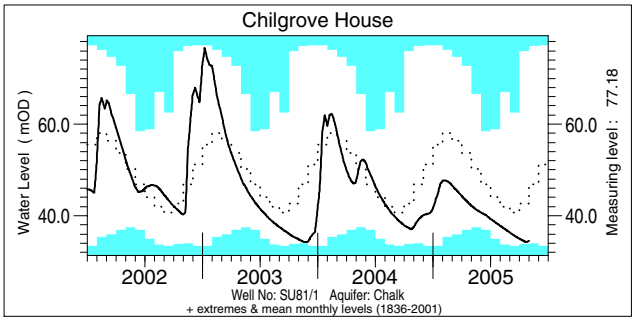


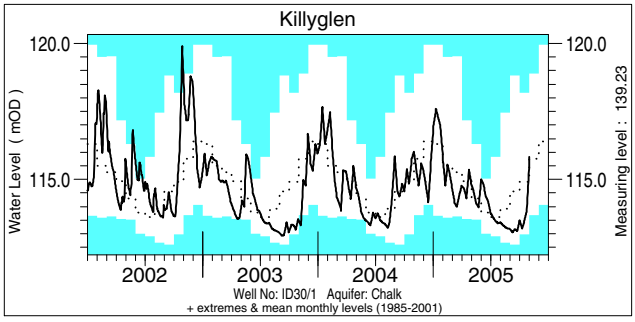


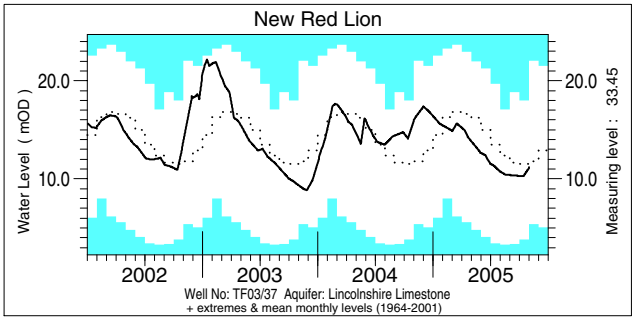






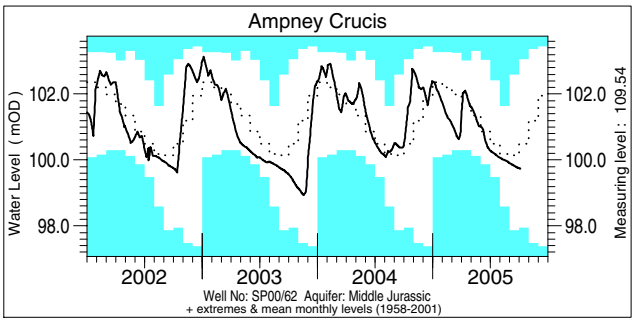


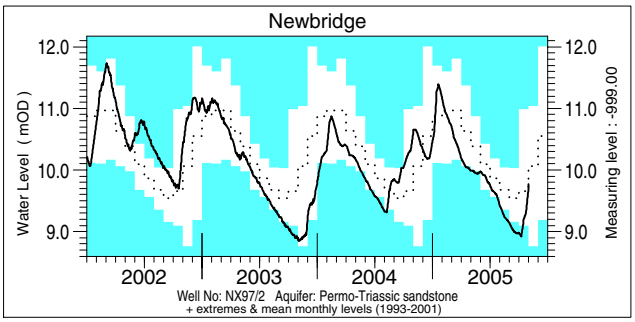


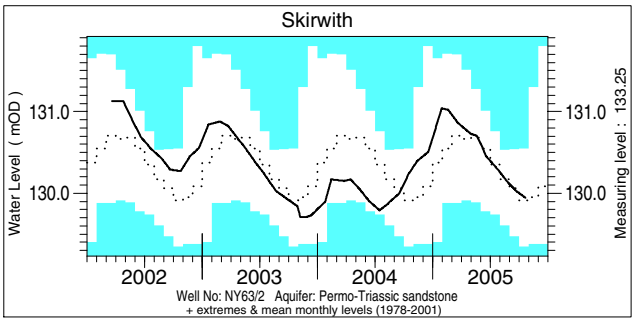


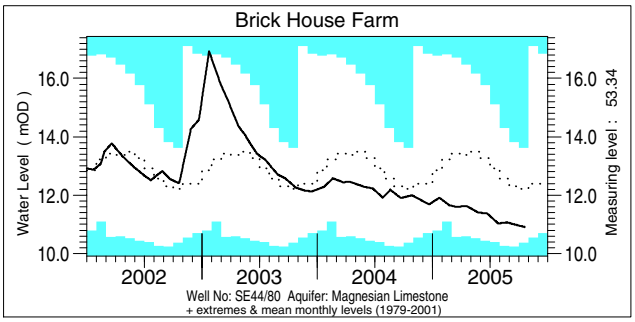
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

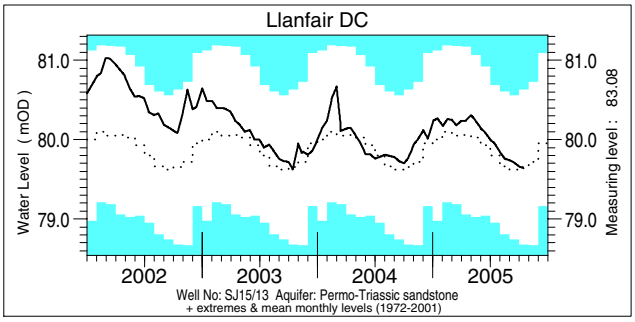
Groundwater . . . Groundwater

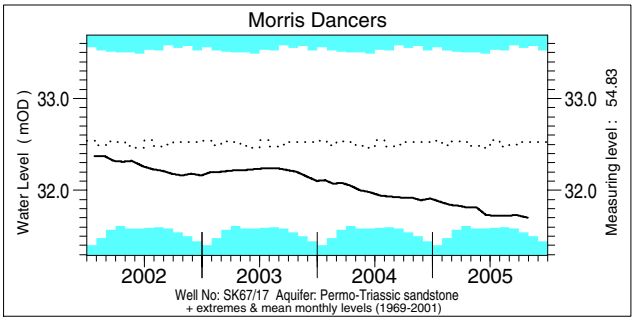


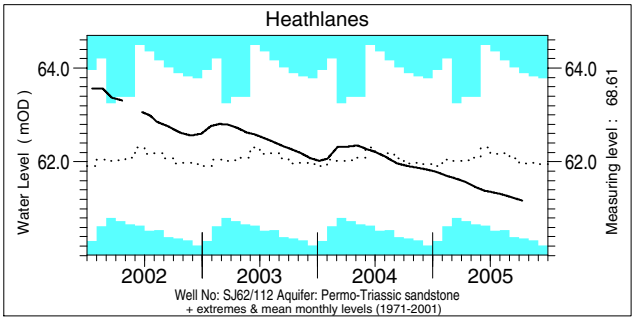


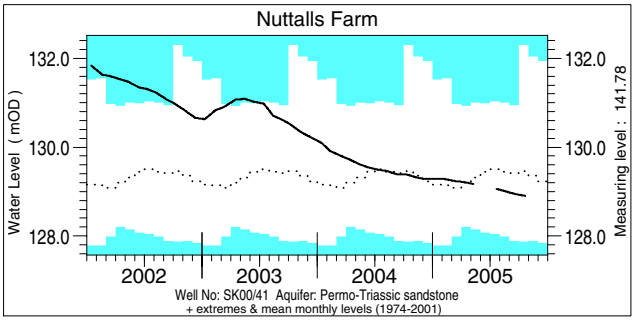


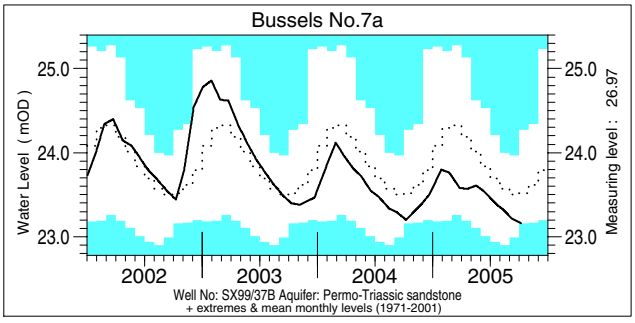


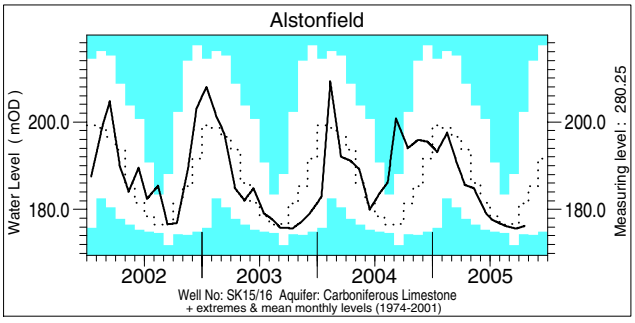










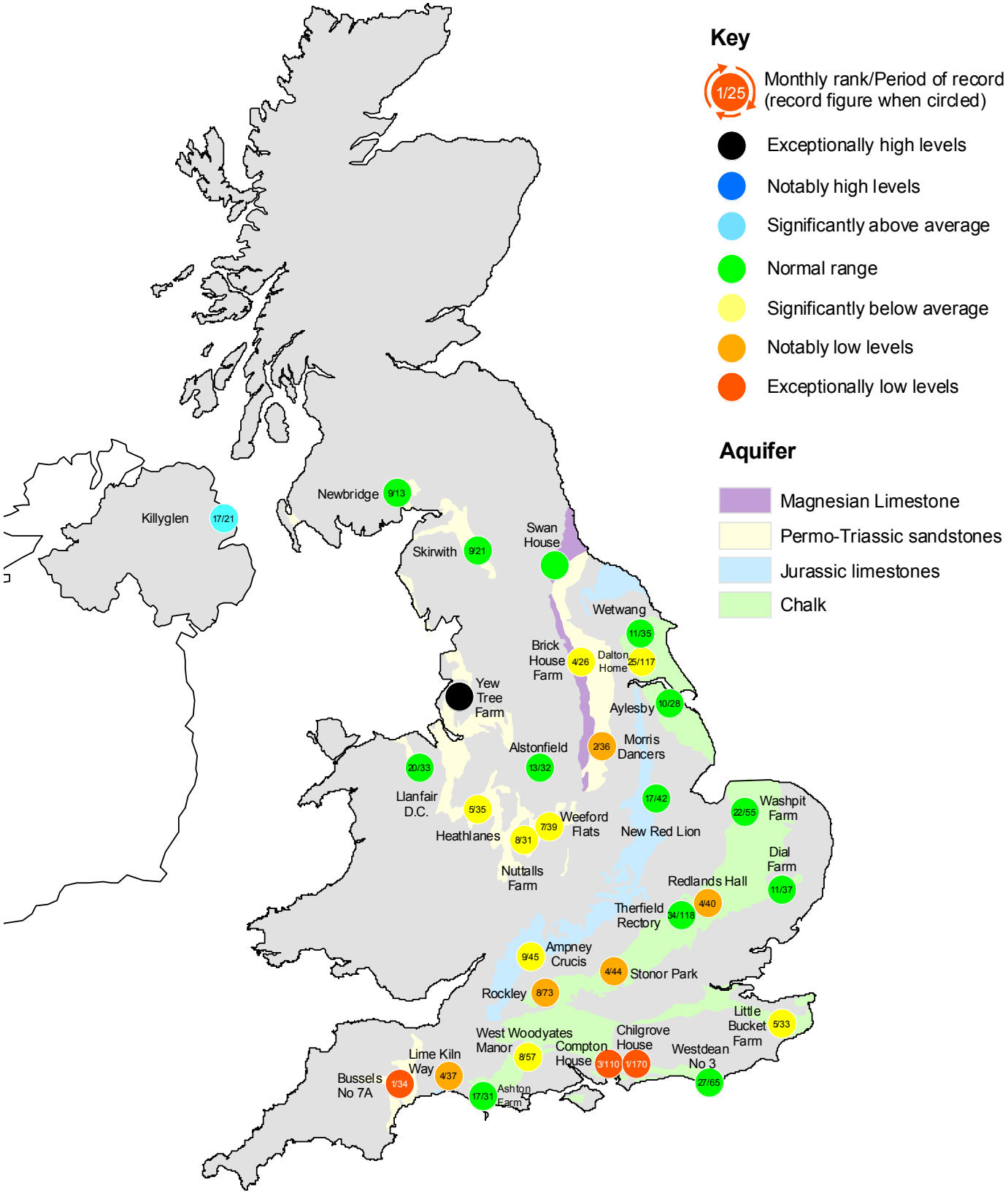


Groundwater levels October/ November 2005

Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.
Dalton Holme	13.63	13/10	14.88	Chilgrove House	34.58	31/10	42.41	Llanfair DC	79.64	15/10	79.55
Washpit Farm	43.20	03/11	43.54	Killyglen	115.83	31/10	114.80	Morris Dancers	31.70	28/10	32.38
Stonor Park	63.45	01/11	73.47	New Red Lion	11.18	31/10	11.61	Heathlanes	61.17	11/10	61.98
Dial Farm	25.31	13/10	25.47	Ampney Crucis	99.74	05/10	100.44	Nuttalls Farm	128.90	21/10	129.64
Rockley	129.25	01/11	130.66	Newbridge	9.77	31/10	9.68	Bussels No.7a	23.16	06/10	23.52
Little Bucket Farm	59.32	31/10	63.52	Skirwith	129.94	21/10	129.95	Alstonfield	176.27	19/10	181.41
West Woodyates	69.06	31/10	75.02	Brick House Farm	10.91	19/10	12.25				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



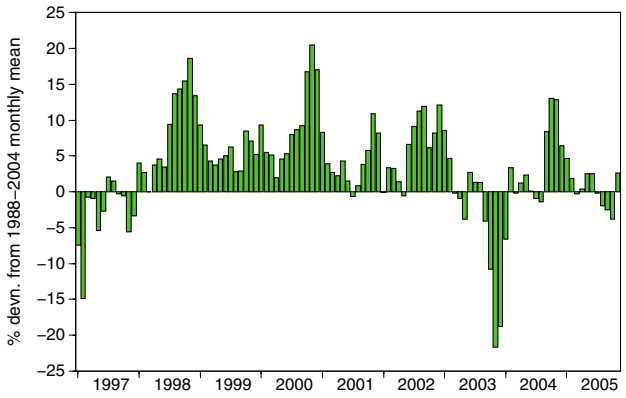
Groundwater levels - October 2005

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.

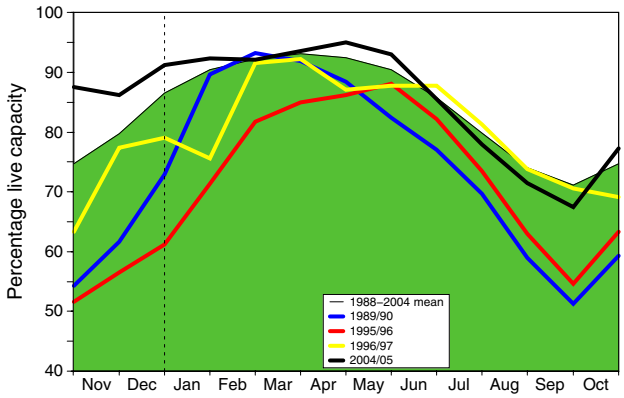
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

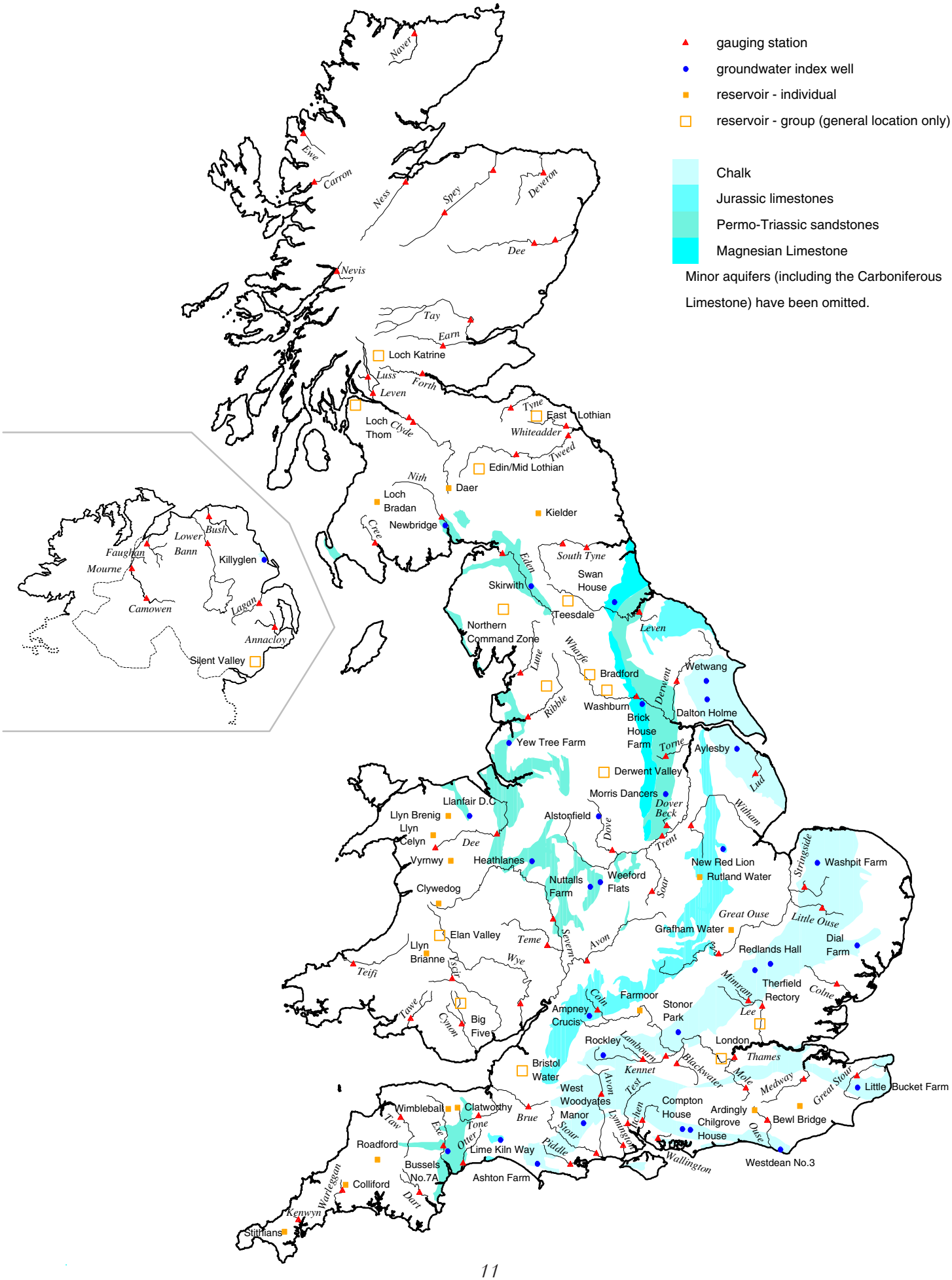
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2005 Jul	Aug	Sep	Oct	Nov	Avg. Nov	Min. Nov	Year* of min.
North West	N Command Zone	• 124929	72	57	49	52	**74**	61	33	2003
	Vyrnwy	55146	84	75	63	56	**82**	72	25	1995
Northumbrian	Teesdale	• 87936	87	77	69	73	**85**	68	33	1995
	Kielder	(199175)	(90)	(87)	(89)	(86)	**(98)**	(85)	(63)	1989
Severn Trent	Clywedog	44922	97	87	76	70	**82**	74	38	1995
	Derwent Valley	• 39525	83	72	60	55	**75**	67	15	1995
Yorkshire	Washburn	• 22035	69	62	57	57	**69**	64	15	1995
	Bradford supply	• 41407	80	70	57	55	**65**	69	16	1995
Anglian	Grafham	(55490)	(89)	(86)	(82)	(80)	**(79)**	(80)	(44)	1997
	Rutland	(116580)	(89)	(85)	(82)	(76)	**(73)**	(78)	(59)	1995
Thames	London	• 202406	89	80	74	65	**65**	74	46	1996
	Farmoor	• 13822	99	99	98	98	**100**	87	43	2003
Southern	Bewl	28170	69	61	54	44	**39**	63	33	1990
	Ardingly	4685	82	65	56	47	**44**	67	15	2003
Wessex	Clatworthy	5364	87	80	66	53	**55**	61	14	2003
	Bristol WW	• (38666)	(75)	(65)	(55)	(47)	**(47)**	(60)	(24)	1990
South West	Colliford	28540	67	62	54	45	**46**	69	42	1996
	Roadford	34500	71	66	58	53	**57**	70	18	1995
	Wimbleball	21320	88	83	74	61	**62**	65	26	1995
	Stithians	5205	79	67	54	41	**43**	55	18	1990
Welsh	Celyn and Brenig	• 131155	96	86	78	77	**87**	81	48	1989
	Brianne	62140	94	93	88	82	**99**	89	57	1995
	Big Five	• 69762	82	73	62	54	**75**	71	38	2003
	Elan Valley	• 99106	83	75	67	64	**83**	84	37	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	96	85	74	72	**80**	78	48	2003
	East Lothian	• 10206	96	90	78	66	**72**	80	38	2003
Scotland(W)	Loch Katrine	• 111363	94	73	67	81	**95**	84	40	2003
	Daer	22412	94	80	69	69	**100**	88	42	2003
	Loch Thom	• 11840	100	100	100	87	**87**	88	69	2003
Northern Ireland	Total+	• 67270	86	75	71	65	**80**	77	39	1995
	Silent Valley	• 20634	86	74	65	64	**82**	66	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 1988-2005 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:

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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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