Hydrological Summary

for the United Kingdom

December 2010

General

December was a truly remarkable month in climatic terms: the coldest December on record for the UK (by a considerable margin). For Scotland, it was the coldest month since February 1947 and, most notably, Northern Ireland registered its coldest month on record. A large proportion of the December precipitation fell as snow (accumulations locally exceeded 50cm) but regional precipitation totals were well below average and the UK registered its driest December since 1963. This is reflected in relatively depressed stocks in some western reservoirs (stocks at Clatworthy were the 2nd lowest for early January in a 24-yr series). Nonetheless, overall reservoir stocks for England &Wales remain only around 3% below the early January average. Burst pipes contributed to inadequate stocks in a number of service reservoirs, most notably in Northern Ireland where water supplies to c40,000 properties were affected – rota cuts were introduced and bowsers deployed; bottled water was also made available in many areas. With catchments frozen for the majority of the month, runoff and recharge conditions were of a type not experienced for 30 years. Snowmelt during a few brief milder interludes contributed to some modest spates but river flows were mostly in recession – and estimated December outflows from the UK were the lowest since 1975. The limited rainfall, combined with frozen ground conditions, resulted in very meagre aquifer recharge and groundwater levels are considerably below average over wide areas. Entering 2011, the water resources outlook is spatially variable but across much of the country the late-winter/early spring rainfall will be particularly influential; a dry January-March could lead to some water resources stress.

Rainfall

Synoptically, December was most notable for the lack of Atlantic frontal systems and the predominance of airflows from the north-eastern quadrant. These resulted in very substantial snow accumulations in many areas: >40cm in parts of eastern Scotland and the northern Pennines by the 2nd (when 15cm fell at Gatwick). On the 8th, the heaviest snowfall for 45 years in Edinburgh contributed to accumulations of >25cm, and on the 17th, 25-30cm accumulations were reported for parts of the Welsh uplands, and Northern Ireland experienced its heaviest snowfall for a generation. Across the UK, road, rail and air transport was severely affected, over 6000 schools closed and, locally, fuel and food supplies were under threat. Despite the substantial snowfall (which implies some underestimation in the monthly precipitation totals), regional precipitation totals for December were mostly <50% of the average; a number of western and central areas registered <25%. Provisional figures indicate that the UK recorded its 3rd driest December in a series from 1914. As notably in a water resources context, significant rainfall deficiencies have built up since the early autumn. Rainfall in the September-December timeframe is >25% below average in many regions, and the lowest since 1988 across broad swathes of England & Wales, and the Highland region of Scotland. Moderate longer term rainfall deficiencies also characterise much of Wales and southern England. Provisional data indicate that 2010 was the driest year since 1976 and 1975 for Wales and the Wessex region respectively. Only Northumbria and North East Scotland registered above average regional rainfall totals for 2010.

River flows

With catchments frozen over wide areas, river flows were in recession through much of December and some notably low flows were reported around the Christmas period (e.g. in the Luss, Clyde and Wye). There were some significant spates – mostly during the short milder interludes when thaw rates were particularly influential. Flood alerts were common across north-eastern Britain on the 11th (e.g. on the Don and Gala Water) and snowmelt from the North York Moors generated a sustained spate on the Yorkshire Derwent. Modest floodplain inundations were reported across southern England and in Northern Ireland around the 27th. Exceptional snowmelt contributions resulted in a new maximum December runoff total for the Tyne (Lothians Region). This was, however, very atypical in a national context. December mean flows were well below average in almost all index catchments away from the eastern seaboard. The Tay, Exe, Tywi and Welsh Dee (each with records >50 years) were among a significant minority of index rivers establishing new December minimum runoff totals. December flows were less depressed across the English Lowlands but for many groundwater-fed streams (e.g. the Lambourn) there is, as yet, no sign of the normal seasonal recovery in flow rates. Runoff for 2010 as a whole was the lowest since 1997 at the national scale, with particularly notable runoff deficiencies in western catchments. In Scotland, the Luss, Nevis and Carron each eclipsed their previous annual minimum runoff.

Groundwater

Ordinarily, December is a month when healthy recharge rates reinforce the seasonal recovery in groundwater levels. In 2010, precipitation was <60% of average across most major aquifer areas and, with moderate residual soil moisture deficits (in central and eastern areas especially) and frozen ground conditions, infiltration was minimal throughout much of the month. The paucity of the December recharge is evident from the late-2010 decline in groundwater levels in a number of responsive wells and boreholes (e.g. Ampney Crucis and Alstonfield) and the stalling of the seasonal recovery in others (see Chilgrove in particular). For some wells, mostly in the western Chalk outcrops, there is no evidence of a sustained seasonal recovery and the protracted recessions from the spring of 2010 have left groundwater levels very close to natural base levels. At Tilshead in the western Chalk, the December level was the 2nd lowest in a series from 1966. Elsewhere, December levels in index wells were generally well below the early winter average but appreciably above drought minima. The most depressed water-tables are concentrated in the Permo-Triassic sandstones of the west Midlands and north Wales, and the southern Chalk (where many winterbournes still remain dry).

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

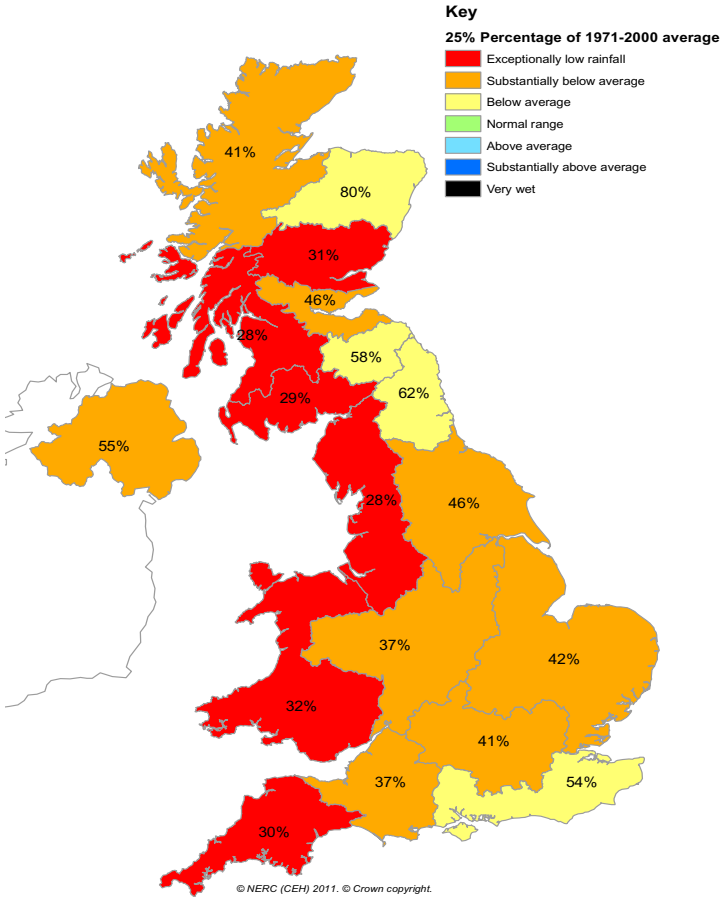
Area	Rainfall	Dec 2010	Oct 10 - Dec10	RP	Jul10 - Dec10	RP	Apr10 - Dec10	RP	Jan10 - Dec10	RP
England & Wales	**mm**	**38**	**211**		**472**		**569**		**778**	
	%	**38**	**75**	**5-10**	**98**	**2-5**	**86**	**5-10**	**87**	**5-15**
North West	mm	**37**	274		677		774		980	
	%	**28**	72	5-10	103	2-5	89	5-10	83	10-20
Northumbrian	mm	**54**	287		546		636		878	
	%	**62**	117	2-5	123	2-5	102	2-5	106	2-5
Severn Trent	mm	**29**	157		370		475		633	
	%	**37**	71	10-20	92	2-5	83	5-15	83	10-20
Yorkshire	mm	**41**	229		459		544		750	
	%	**46**	94	2-5	106	2-5	90	5-10	92	2-5
Anglian	mm	**24**	127		337		413		576	
	%	**42**	75	5-10	105	2-5	88	2-5	96	2-5
Thames	mm	**30**	149		334		414		605	
	%	**41**	71	5-10	90	2-5	78	10-20	86	5-10
Southern	mm	**48**	213		388		477		728	
	%	**54**	82	2-5	91	2-5	81	5-10	93	2-5
Wessex	mm	**37**	191		387		480		684	
	%	**37**	69	5-10	83	5-10	75	15-25	79	15-25
South West	mm	**45**	282		588		699		991	
	%	**30**	69	5-10	90	2-5	81	5-10	82	5-15
Welsh	mm	**50**	294		691		827		1082	
	%	**32**	66	15-25	95	2-5	86	5-15	82	25-40
Scotland	**mm**	**65**	**368**		**789**		**965**		**1243**	
	%	**40**	**78**	**5-10**	**100**	**<2**	**94**	**2-5**	**86**	**5-10**
Highland	mm	**82**	383		861		1068		1359	
	%	**41**	66	5-15	91	2-5	89	2-5	79	10-20
North East	mm	**73**	301		667		825		1114	
	%	**80**	103	2-5	129	5-10	117	2-5	117	5-10
Tay	mm	**44**	393		783		946		1200	
	%	**31**	97	2-5	116	2-5	107	2-5	95	2-5
Forth	mm	**57**	309		658		799		1051	
	%	**46**	87	2-5	107	2-5	98	2-5	93	2-5
Tweed	mm	**60**	277		574		668		952	
	%	**58**	94	2-5	112	2-5	95	2-5	100	<2
Solway	mm	**48**	390		777		947		1216	
	%	**29**	84	2-5	99	2-5	93	2-5	86	5-10
Clyde	mm	**55**	431		925		1109		1394	
	%	**28**	75	5-10	95	2-5	90	2-5	80	10-20
Northern Ireland	**mm**	**64**	**282**		**645**		**791**		**1048**	
	%	**55**	**82**	**2-5**	**107**	**2-5**	**97**	**2-5**	**94**	**2-5**

% = percentage of 1971-2000 average *RP = Return period*

Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1913; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. All monthly rainfall totals since July 2010 are provisional.

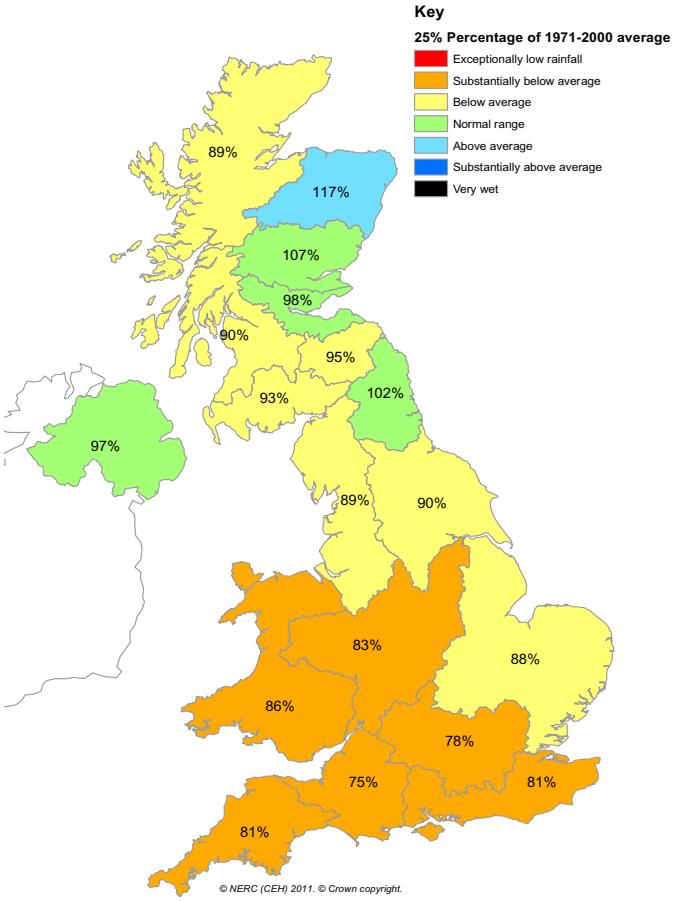
Rainfall . . . Rainfall . . .

December 2010

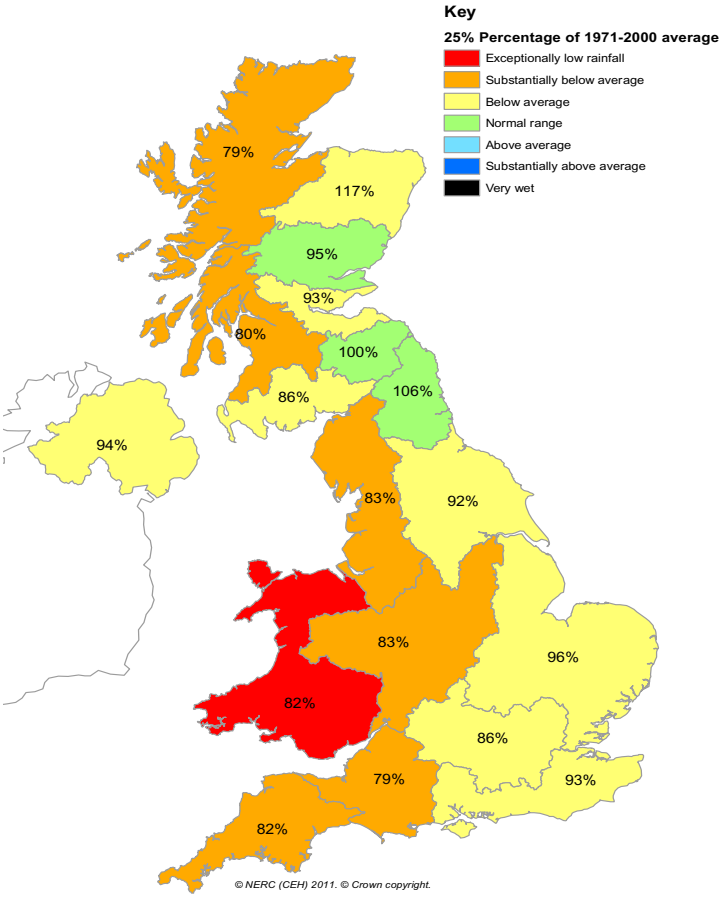


Precipitation in December 2010 could be underestimated due to the high proportion of snow.

April - December 2010



January - December 2010



Met Office Weather forecast

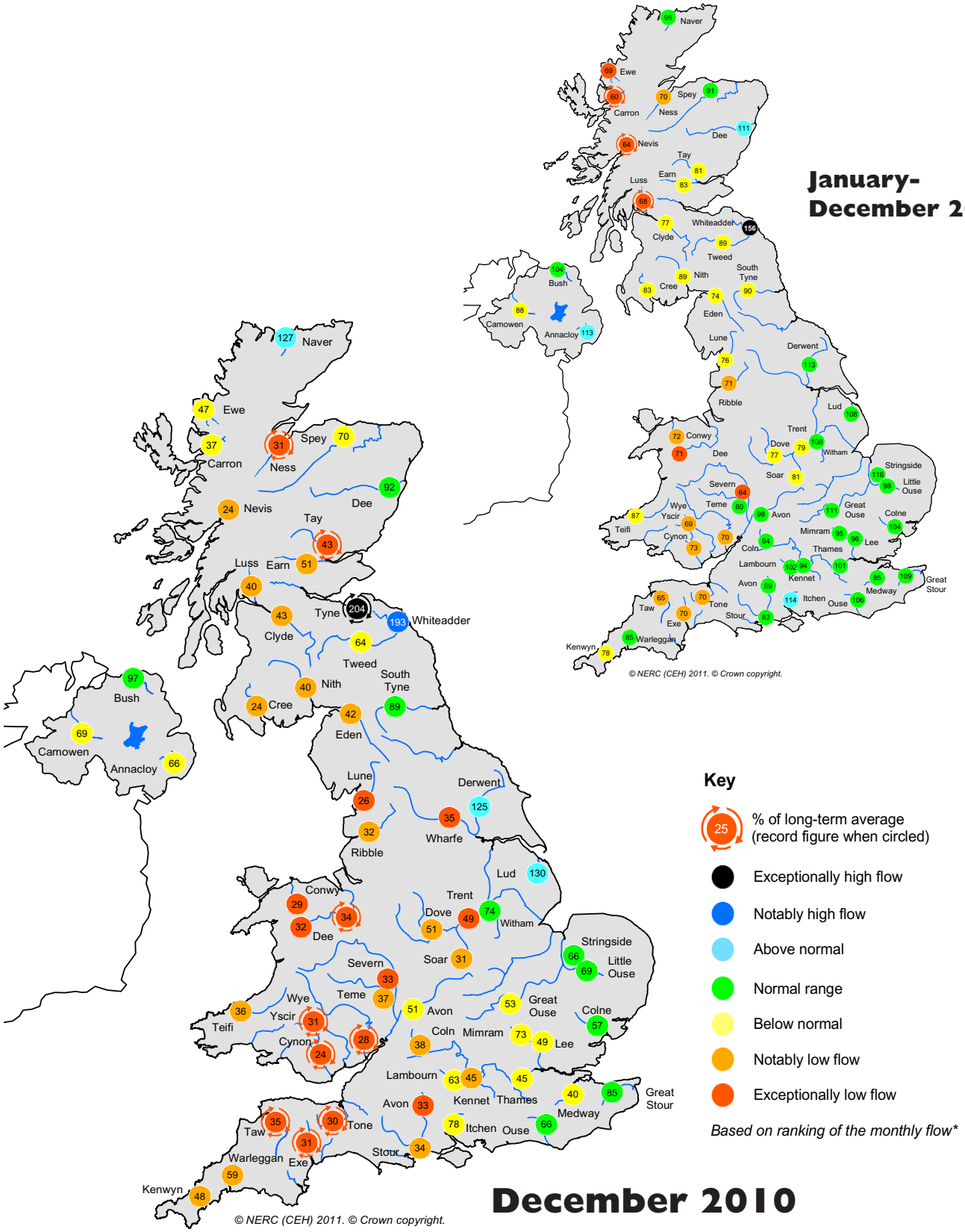
Updated: 13:20 on Weds 12 Jan 2011

UK Outlook for Monday 17 Jan to Wednesday 26 Jan 2011: A rather unsettled working week, with windy conditions at first. Rain or showers are likely to affect the north and west of the UK at times, with drier and clearer spells perhaps more frequent in the south and east. Temperatures start the week near-normal in the north, with the south above average, although both regions should exhibit a downward trend towards the weekend. Frost and hill snow is possible from Wales northwards at first, before the falling temperatures perhaps lead to snow in the north falling to lower levels. In addition to this, the frost risk spreads southwards with icy stretches becoming a possibility behind spells of rain. From the weekend, indications are for a rather cold and unsettled theme to end the period, but with some drier spells likely.

UK Outlook for Thursday 27 Jan to Thursday 10 Feb 2011: Unsettled and sometimes windy weather is expected through this period, with showers or longer spells of rain. This is likely to turn to snow at times, especially in the north and over high ground in the south. Some drier and brighter interludes are also expected, but with the risk of sharp frosts and overnight fog. Temperatures are expected to be generally near or below average, perhaps well below average at times across north-eastern parts of England and Scotland, though a few milder days are possible at first, especially in the south.

For further details please visit:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_alltext.html

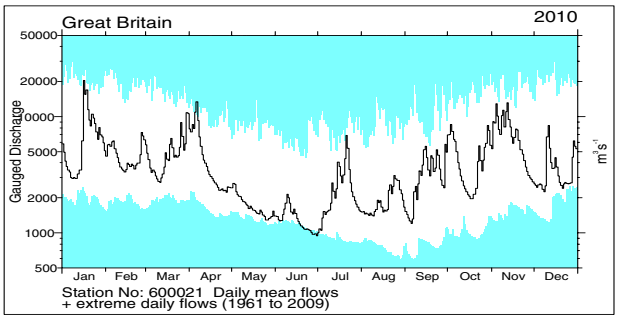
River flow . . . River flow . . .

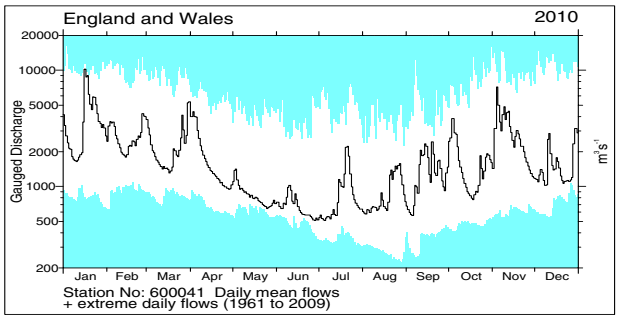


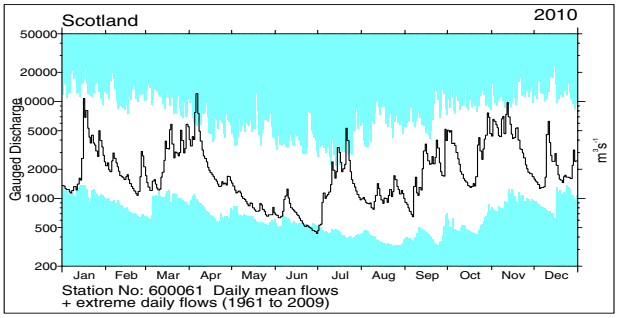
River flows

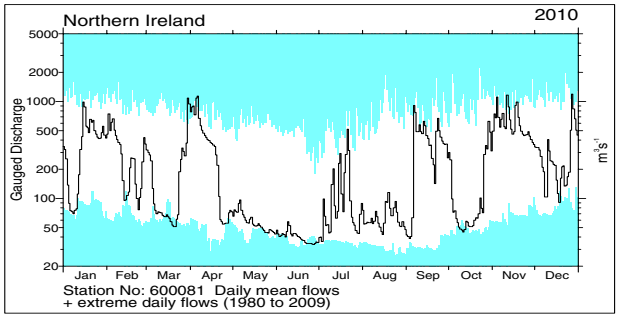
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

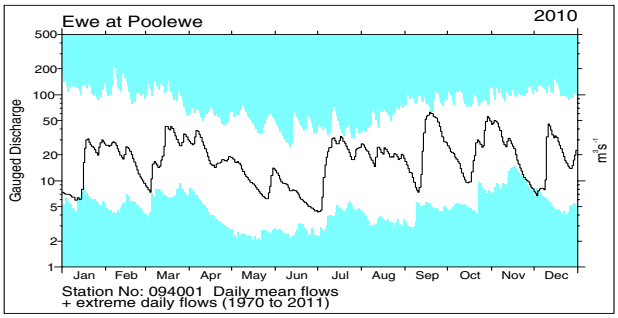
River flow . . . River flow . . .

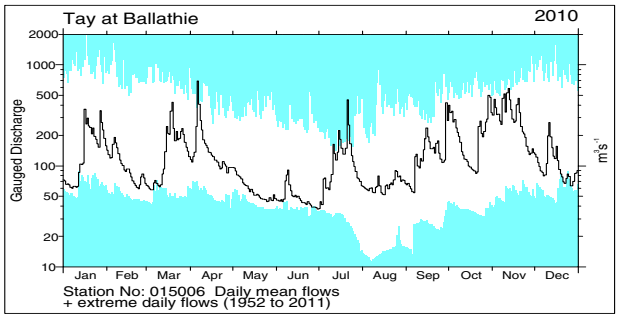


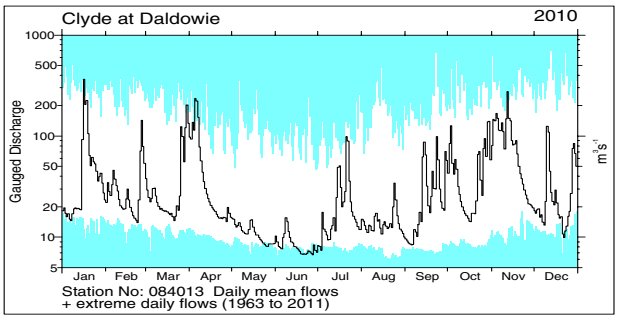


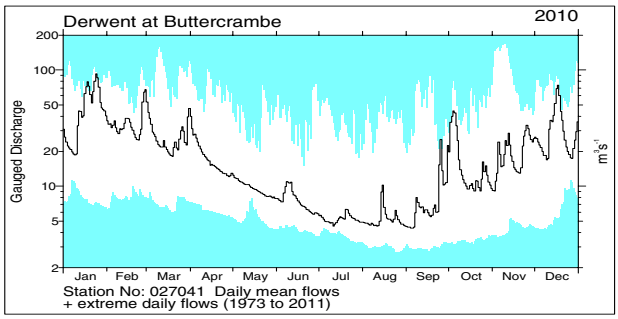


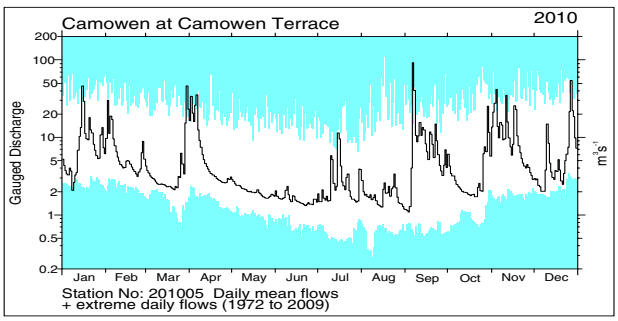


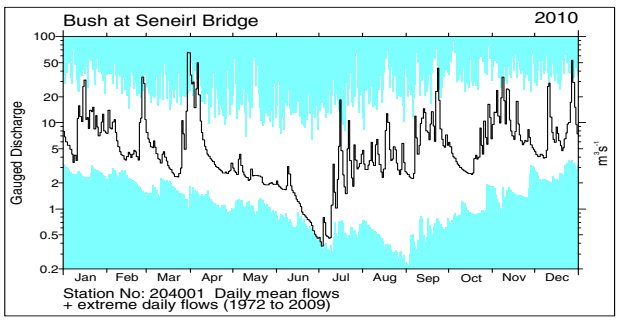








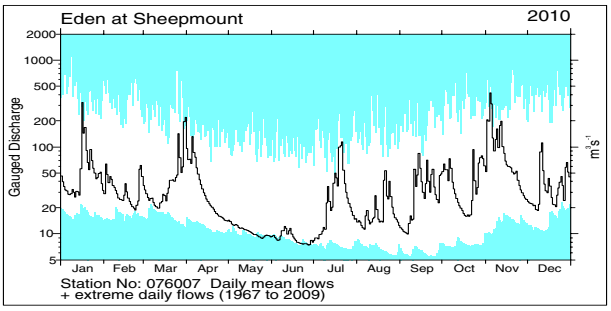


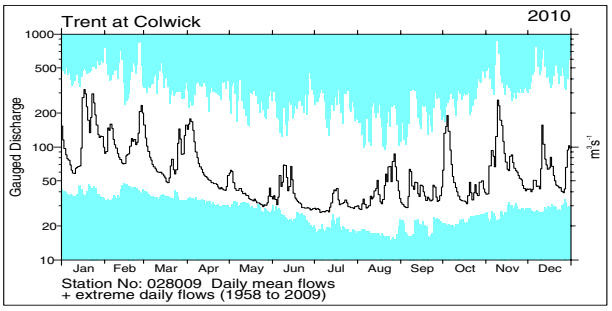


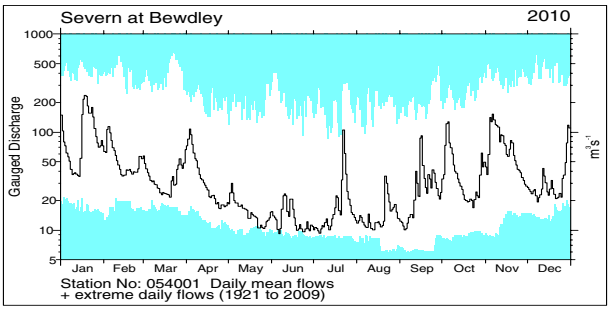
River flow hydrographs

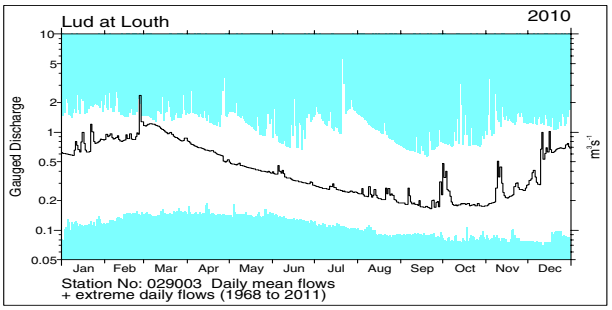
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to January 2010 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

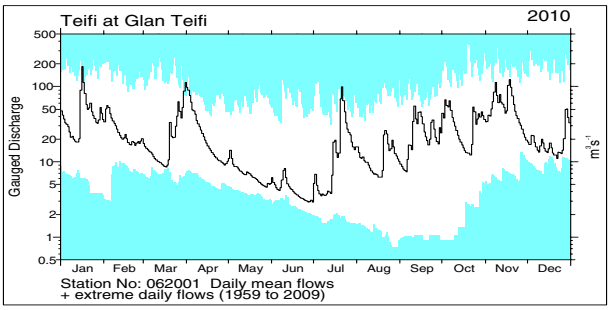
River flow . . . River flow . . .

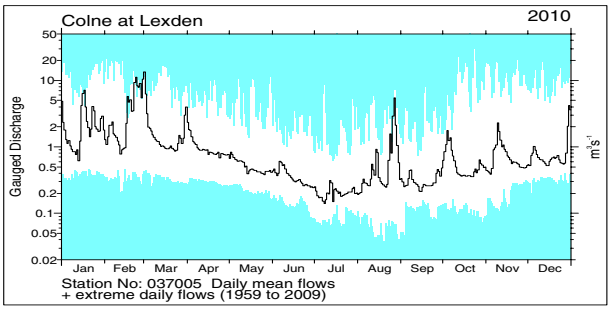


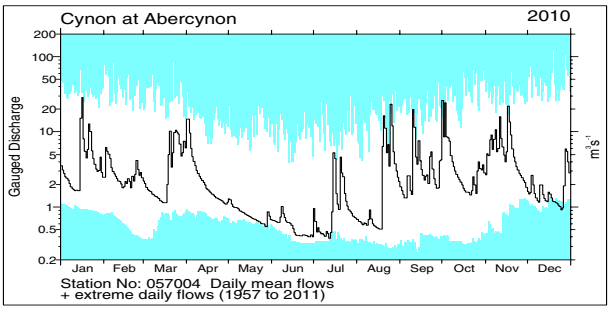


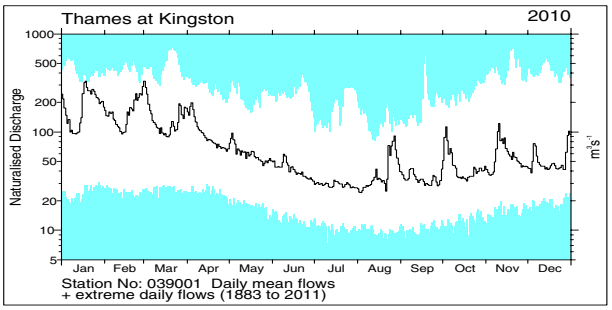


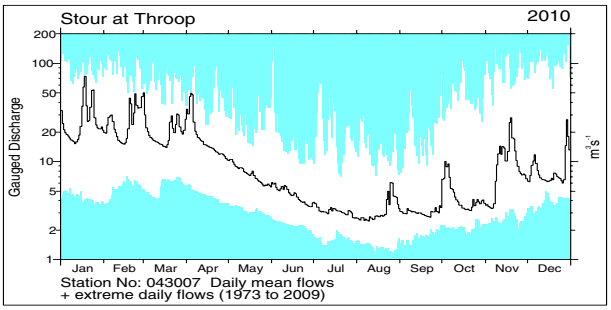


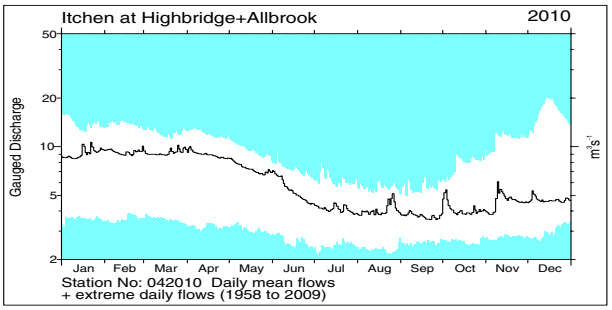












Notable runoff accumulations (a) October - December 2010 (b) January - December 2010

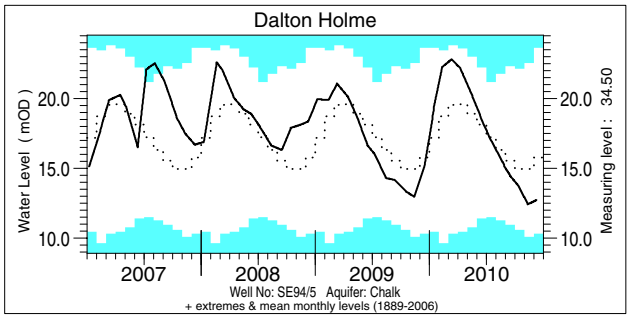
	River	%lta	Rank
a)	Kennet	61	7/50
	Avon (Amesbury)	50	4/46
	Stour	46	4/38
	Brue	40	2/45
	Yscir	65	6/38
	Conwy	66	4/44
	Dee (New Inn)	68	4/42

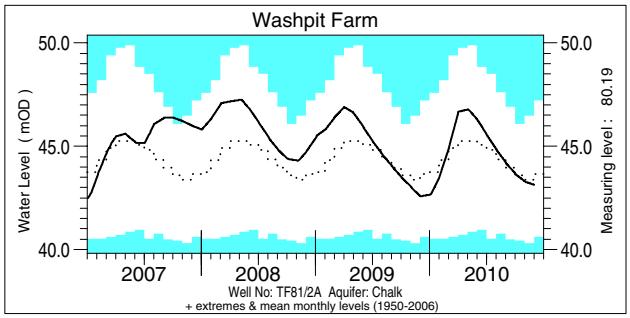
	River	%lta	Rank
b)	Ness	70	3/38
	Forth	67	2/29
	Tyne (Spilmersford)	160	44/45
	Whiteadder	156	40/41
	Exe	70	5/54
	Taw	65	3/52
	Tone	70	4/49
	Severn	64	4/89

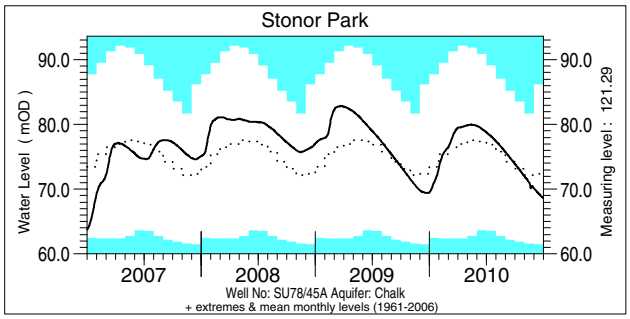
	River	%lta	Rank
b)	Dee (Manley Hall)	73	5/73
	Ribble	71	5/50
	Luss Water	68	1/32
	Nevis	64	1/28
	Carron	60	1/32
	Ewe	69	2/40
	Faughan	80	5/34

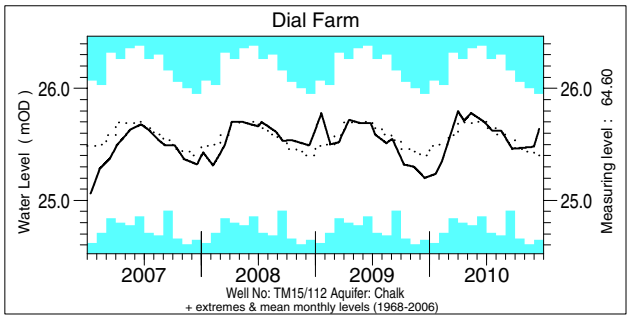
lta = long term average
Rank 1 = lowest on record

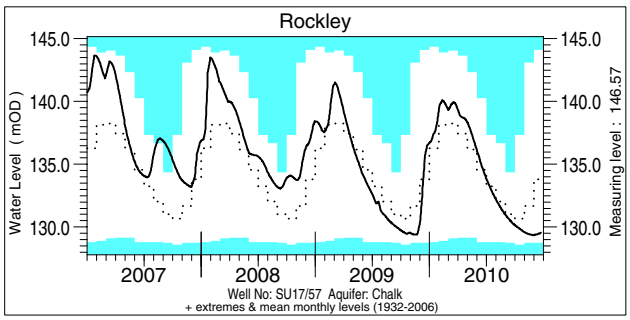
Groundwater . . . Groundwater

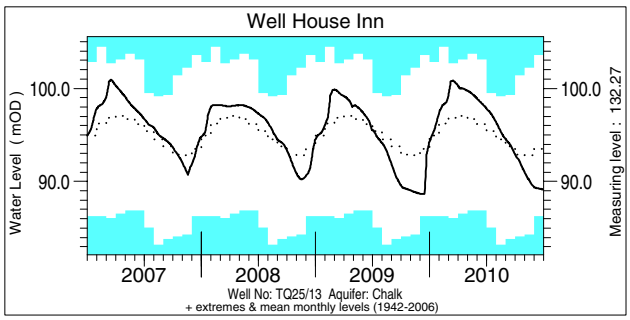


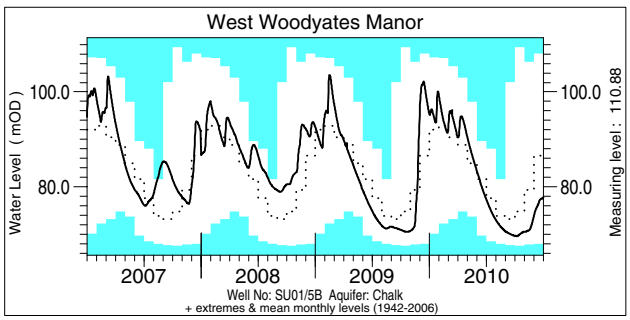


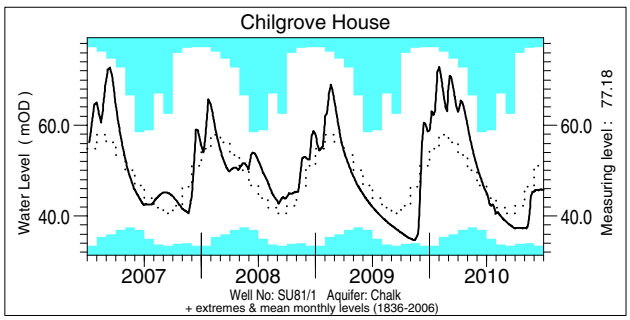


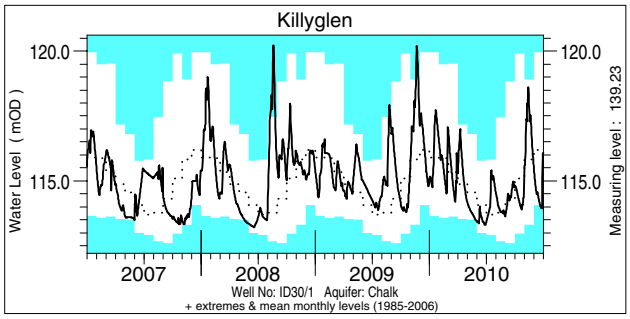


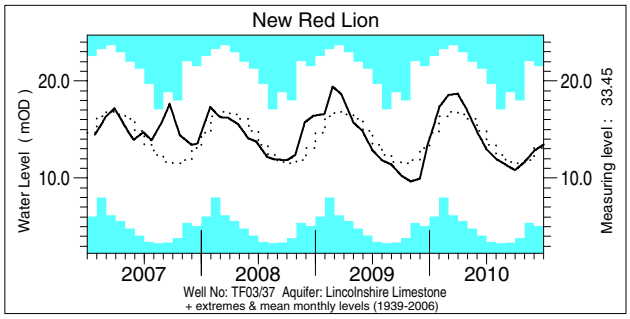






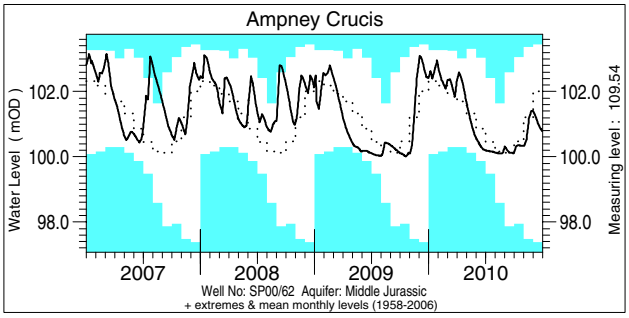


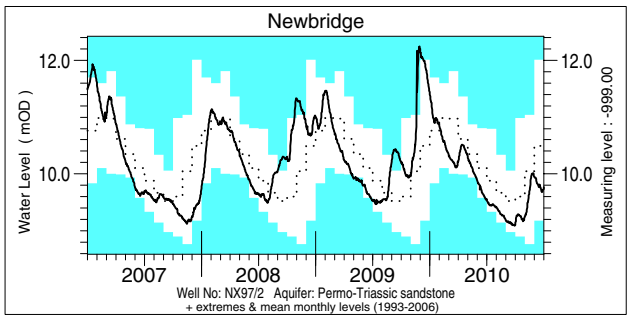


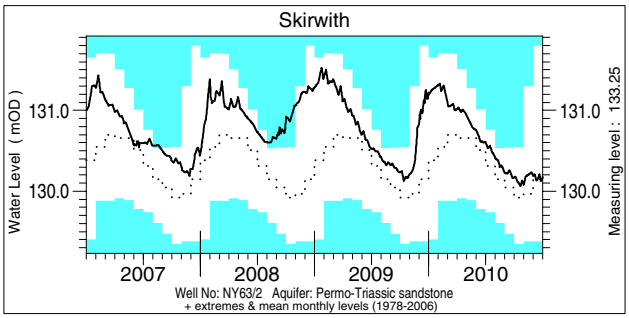


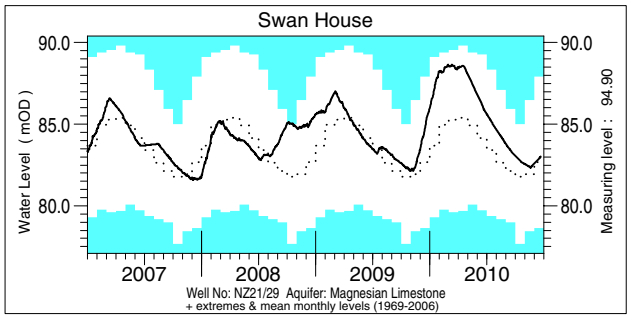
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

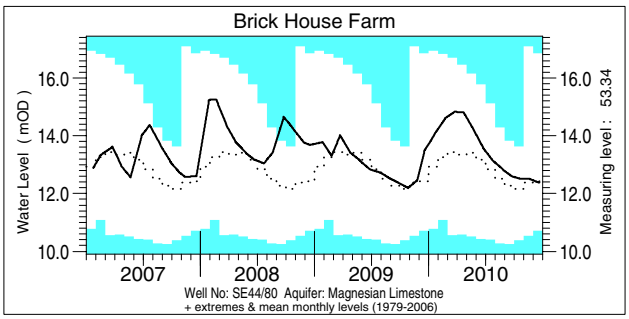
Groundwater . . . Groundwater

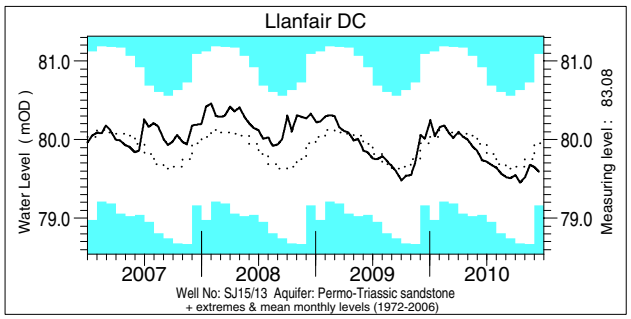


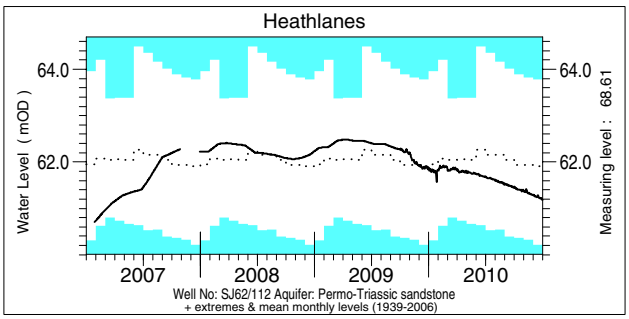


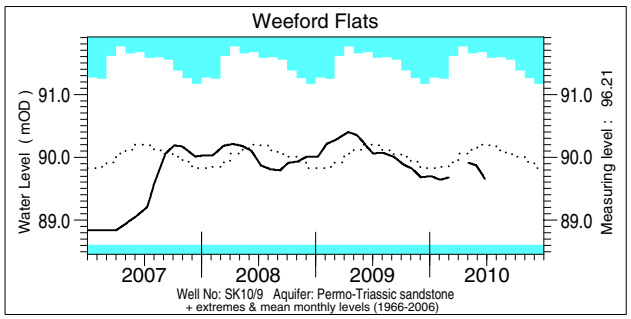


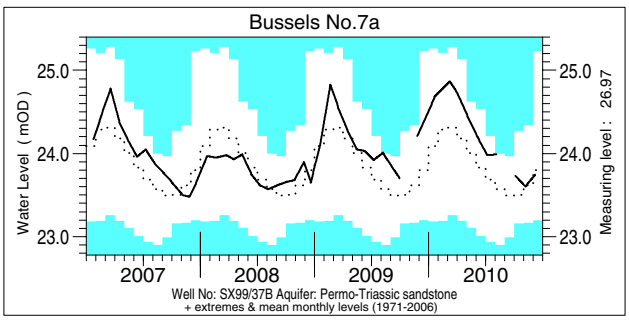


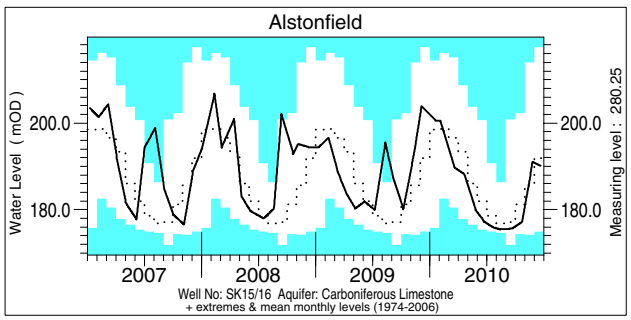








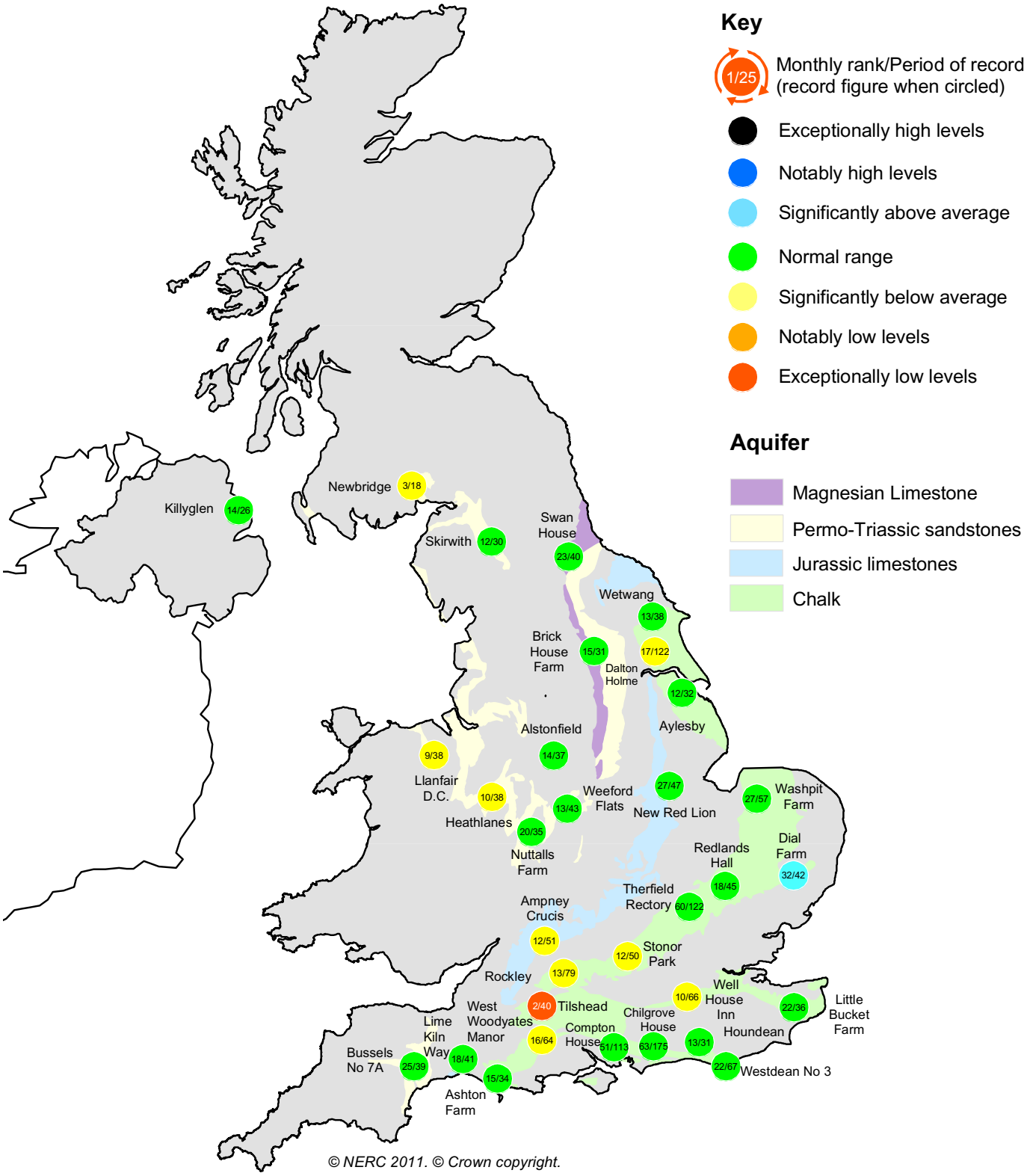




Groundwater levels December 2010 / January 2011

Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.
Dalton Holme	12.74	08/12	15.59	Chilgrove House	45.71	31/12	51.95	Brick House Farm	12.37	20/12	12.48
Washpit Farm	43.25	05/01	43.42	Killyglen (NI)	116.07	31/12	116.12	Llanfair DC	79.59	15/12	79.89
Stonor Park	68.39	04/01	72.40	New Red Lion	13.48	31/12	13.04	Heathlanes	61.19	31/12	61.89
Dial Farm	25.64	16/12	25.39	Ampney Crucis	101.61	04/01	102.01	Weeford Flats	89.19	04/01	89.66
Rockley	129.63	29/12	133.92	Newbridge	9.80	01/01	10.56	Bussels No.7a	23.89	10/01	23.83
Well House Inn	89.06	04/01	93.56	Skirwith	130.18	31/12	130.31	Alstonfield	190.11	20/12	193.05
West Woodyates	77.72	31/12	87.23	Swan House	83.03	21/12	82.72	*Levels in metres above Ordnance Datum*			

Groundwater . . .Groundwater



Groundwater levels - December 2010

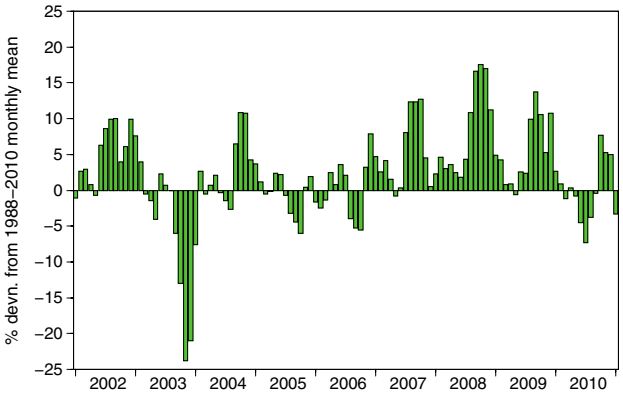
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing 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.

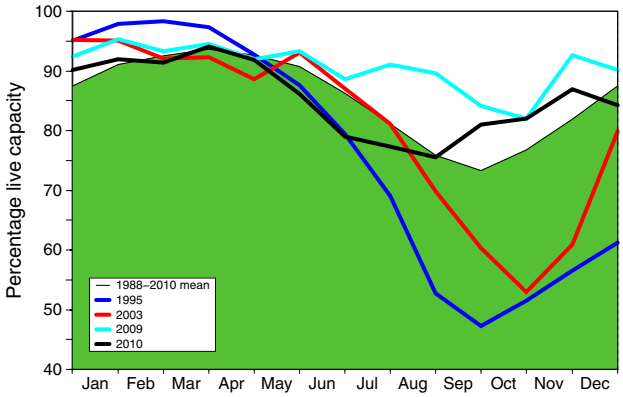
ii. Yew Tree Farm levels are now received quarterly.

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)	2010 Nov	Dec	2011 Jan	Jan Anom.	Min Jan	Year* of min	2010 Jan	Diff 11-10
North West	N Command Zone	•	124929	70	83	**66**	-21	51	1996	90	-24
	Vyrnwy		55146	79	96	**82**	-9	35	1996	90	-8
Northumbrian	Teesdale	•	87936	86	90	**90**	3	41	1996	87	3
	Kielder		(199175)	(89)	(88)	**(89)**	-1	(70)	1990	(87)	2
Severn Trent	Clywedog		44922	85	86	**86**	3	54	1996	79	7
	Derwent Valley	•	39525	70	85	**84**	-6	10	1996	92	-8
Yorkshire	Washburn	•	22035	75	89	**84**	0	23	1996	96	-12
	Bradford supply	•	41407	70	92	**84**	-6	22	1996	98	-14
Anglian	Grafham		(55490)	(95)	(95)	**(89)**	5	(57)	1998	(85)	4
	Rutland		(116580)	(75)	(75)	**(76)**	-6	(60)	1991	(75)	1
Thames	London	•	202828	89	89	**89**	3	60	1991	96	-7
	Farmoor	•	13822	99	87	**91**	0	71	1991	86	5
Southern	Bewl		28170	48	51	**65**	-8	34	2006	86	-21
	Ardingly		4685	68	75	**85**	0	41	2004	97	-12
Wessex	Clatworthy		5364	36	60	**56**	-36	54	2004	100	-44
	Bristol WW	•	(38666)	(50)	(54)	**(51)**	-28	(40)	1991	(100)	-49
South West	Colliford		28540	75	79	**79**	1	46	1996	94	-15
	Roadford		34500	67	72	**69**	-10	23	1996	99	-30
	Wimbleball		21320	51	62	**61**	-24	46	1996	100	-39
	Stithians		4967	51	64	**77**	0	33	2002	100	-23
Welsh	Celyn and Brenig	•	131155	94	97	**94**	2	54	1996	92	2
	Brianne		62140	97	92	**95**	-2	76	1996	96	-1
	Big Five	•	69762	92	100	**89**	0	67	1996	89	0
	Elan Valley	•	99106	84	99	**99**	2	56	1996	100	-1
Scotland(E)	Edinburgh/Mid Lothian	•	97639	79	90	**88**	-2	60	1999	99	-11
	East Lothian	•	10206	98	100	**100**	5	48	1990	100	0
Scotland(W)	Loch Katrine	•	111363	93	90	**78**	-12	75	2008	89	-11
	Daer		22412	99	99	**91**	-6	83	1996	99	-8
	Loch Thom	•	11840	95	96	**96**	0	80	2008	96	0
Northern Ireland	Total+	•	56920	87	92	**92**	7	61	2002	96	-4
	Silent Valley	•	20634	89	93	**92**	10	39	2002	92	0

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

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2009 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

Location map . . . Location map

National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP)[#] is undertaken jointly by the Centre for Ecology & Hydrology (CEH) 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 Northern Ireland Environment Agency. 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 Northern Ireland Water.

The National River Flow Archive (maintained by CEH) 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 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.
The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

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

[#] Instigated in 1988

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The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged; the December Summary, in particular, stands as a testament to the assistance provided by many hydrometric personnel working in exceptionally challenging circumstances.

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Selected text and maps are available on the WWW at
http://www.ceh.ac.uk/data/nrfa/index.html
Navigate via National Hydrological Monitoring Programme.

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