Hydrological Summary for the United Kingdom

April 2011

General

April was a very remarkable month in hydrometeorological terms: provisionally it was the warmest April in the 352-year Central England Temperature series, estimated outflows from Britain were the lowest on record for the last week of April, and the end-of-month soil moisture deficits were the highest (for E&W) in a 50-year series. The exceptional aridity of the early spring (see scatter plot on page 3), following a relatively dry 2010, has resulted in agricultural and hydrological drought conditions affecting large parts of southern Britain. Currently, the primary impacts are on farmers and growers, an increased risk of forest and heath fires and, importantly, on river flows. Correspondingly, replenishment to most gravity-fed reservoirs was very meagre and overall stocks for E&W registered their 2nd largest March/April decline since 1997. Where practical, water companies have been drawing from alternative sources to help conserve reservoir stocks (e.g. the transfer of River Severn water, via the Sharpness canal, to moderate pressure on the Mendip reservoirs) and early-May stocks in almost all index reservoirs remain above 80% of capacity. Nonetheless, stocks are well below the late-spring average in parts of the South West, Wales and Yorkshire. Groundwater levels are also seasonally depressed in a number of the most responsive aquifer units but levels across most major aquifers remain considerably above drought minima. Historical rainfall figures indicate a tendency for dry spring periods to be followed by above average summer rainfall, but with evaporation rates increasing even average summer rainfall would imply very low late summer river flows – and an associated major contraction in the river network.

Rainfall

Active Atlantic low pressure systems brought substantial rainfall to western Scotland in the first week of April – Tyndrum reported 130mm in 48 hrs – but a blocking high to the east prevented maritime influences extending to the south. Whilst parts of the western Highlands recorded more than twice the April average rainfall, much of the English Lowlands registered lengthy sequences (commonly 20-30 days) with no more than a trace of rainfall. In Oxford, the Radcliffe Met. Station recorded an April total of 0.5mm. Such aridity contributed to the lowest March/April rainfall total since 1938 for England & Wales with a few regions (e.g. Anglian) eclipsing previous minima in series of >100 yrs. The recent exceptionally dry 10-week period, combined with the longer term rainfall deficiencies which began to build in December 2009, has resulted in 17-month rainfall totals falling to around 20% below the 1971-2000 average across Wales, the South West and the Midlands; in this timeframe such modest rainfall accumulations would be expected to occur once every 20-40 years on average. In relation to water resources, the effect of this deficiency has been moderated by the above average February rainfall and, for the larger reservoirs, the fact that they were very close to capacity following the remarkably high rainfall in November 2009.

River flows

Notable peak flows were reported for a number of rivers in northern Britain (e.g. the Ness, Carron and Ewe) during the first week but generally April saw a continuation of the steep early spring recessions. Subsequently the recessions have been punctuated by one or two modest spates but, by late April, flows in responsive catchments were exceptionally depressed (for the spring) over a very wide area. At the national scale (GB) new minimum outflows for late April and early May were established and, around month end, flows in a substantial number of rivers, including the Trent, Exe, Tone, Wye, Tawe and Ribble reported flows similar to, or below, the corresponding flows registered during the extreme drought of 1976. Such depressed flow rates imply a considerable (albeit temporary) loss of aquatic habitat as headwater streams continue to dry up through the coming summer. The April mean flows (see page 4) do not capture the full extent of the spring recessions but they do usefully identify those areas where, generally, the drought is currently most severe; embracing a zone from south-west Britain to the east Midlands (and Northern Ireland). Provisional data suggest that the combined March/April outflows from England & Wales are the lowest in the 50-yr national series. Notable, and widespread, runoff deficiencies can be recognised in timespans up to 17 months, particularly in western catchments. In many English Lowland rivers flows are seasonally depressed but remain above drought minima due to the natural flows from springs and seepages which normally constitute much of the flow through the summer half-year.

Groundwater

April rainfall totals across the outcrop areas of almost all major aquifers was very modest, <15% of average in most areas. This, together with seasonally high evaporative demands and a rapid increase in soil moisture deficits, meant that infiltration was generally negligible. The lack of significant spring recharge is not yet reflected in the groundwater level hydrographs for a few of the slowest-responding aquifer units (e.g. the Chalk at Therfield) but, generally, levels are in a relatively steep decline following an early onset of the seasonal recession. Currently, particularly low levels characterise a number of index wells in the more responsive limestone aquifers: Alstonfield (Carboniferous Limestone) and Ampney Crucis (Middle Jurassic) reporting their 3rd and 4th lowest April levels respectively. Notably low levels also typify the western Chalk outcrop (and Killyglen in Northern Ireland) but, to the east and north, levels are generally below average but considerably above drought minima (which were often registered during the protracted droughts of the 1990s). With late-April smds averaging >80mm across the Chalk outcrop further recharge before the autumn is now a remote possibility. Correspondingly, notably low groundwater levels may be expected through the summer with some responsive wells reaching natural base levels.

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

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

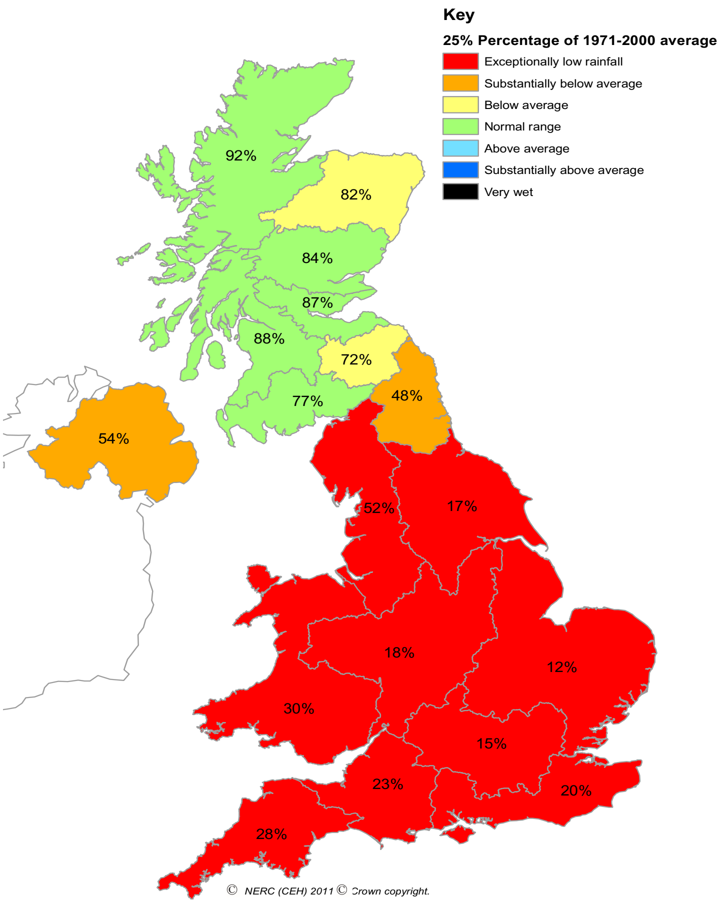
Area	Rainfall	Apr 2011	Mar11 - Apr11	RP	Dec10 - Apr11	RP	May10 - Apr11	RP	Dec09 - Apr11	RP
United	mm	**36**	85		347		968		1351	
Kingdom	%	**55**	54	20-30	72	12-16	89	5-10	86	10-15
England	mm	**12**	31		221		688		1006	
	%	**21**	25	>100	63	20-35	84	8-12	86	8-12
Scotland	mm	**79**	182		545		1373		1841	
	%	**99**	86	2-5	83	2-5	95	2-5	88	5-10
Wales	mm	**29**	61		389		1160		1618	
	%	**36**	31	>100	63	15-25	85	8-12	81	20-30
Northern	mm	**35**	89		348		1011		1403	
Ireland	%	**50**	54	12-16	71	10-20	91	5-10	88	8-12
England &	mm	**14**	35		244		753		1090	
Wales	%	**24**	27	>100	63	20-30	84	8-12	85	10-15
North West	mm	**41**	86		399		1110		1461	
	%	**61**	52	15-25	79	5-10	94	2-5	87	8-12
Northumbria	mm	**19**	61		289		850		1212	
	%	**33**	48	10-20	81	2-5	102	2-5	102	2-5
Midlands	mm	**8**	20		171		594		850	
	%	**15**	18	>100	53	50-80	78	15-20	79	25-40
Yorkshire	mm	**8**	21		220		694		1010	
	%	**14**	17	>100	62	20-30	85	5-10	86	8-12
Anglian	mm	**5**	11		132		512		767	
	%	**10**	12	>100	56	50-80	85	5-10	91	2-5
Thames	mm	**4**	15		177		541		844	
	%	**8**	15	>100	61	15-25	77	10-15	85	5-10
Southern	mm	**4**	23		234		649		1046	
	%	**8**	20	60-90	70	5-10	83	5-10	94	2-5
Wessex	mm	**7**	29		230		646		985	
	%	**13**	23	50-80	60	10-20	75	20-30	79	20-30
South West	mm	**16**	47		312		936		1390	
	%	**23**	28	40-60	55	25-40	77	15-25	78	20-30
Welsh	mm	**27**	57		364		1110		1556	
	%	**34**	30	>100	61	20-30	84	10-15	81	20-30
Highland	mm	**120**	234		645		1531		2024	
	%	**129**	92	2-5	80	2-5	89	2-5	80	8-12
North East	mm	**29**	117		344		1072		1524	
	%	**45**	82	2-5	87	2-5	113	2-5	113	2-5
Tay	mm	**51**	156		483		1303		1723	
	%	**76**	84	2-5	82	2-5	103	2-5	93	2-5
Forth	mm	**48**	144		469		1177		1581	
	%	**77**	87	2-5	93	2-5	104	2-5	97	2-5
Tweed	mm	**35**	102		389		998		1427	
	%	**59**	72	2-5	94	2-5	105	2-5	104	2-5
Solway	mm	**62**	156		561		1398		1888	
	%	**78**	77	2-5	89	2-5	99	2-5	93	2-5
Clyde	mm	**100**	220		658		1617		2118	
	%	**110**	88	2-5	83	2-5	93	2-5	84	5-10

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

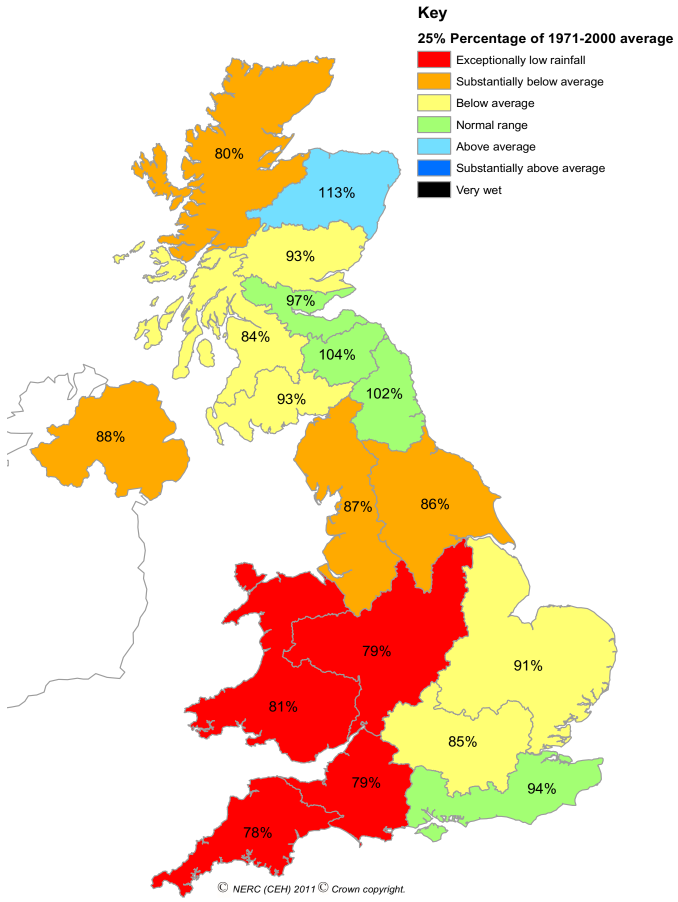
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; 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 November 2010 are provisional.

Rainfall . . . Rainfall . . .

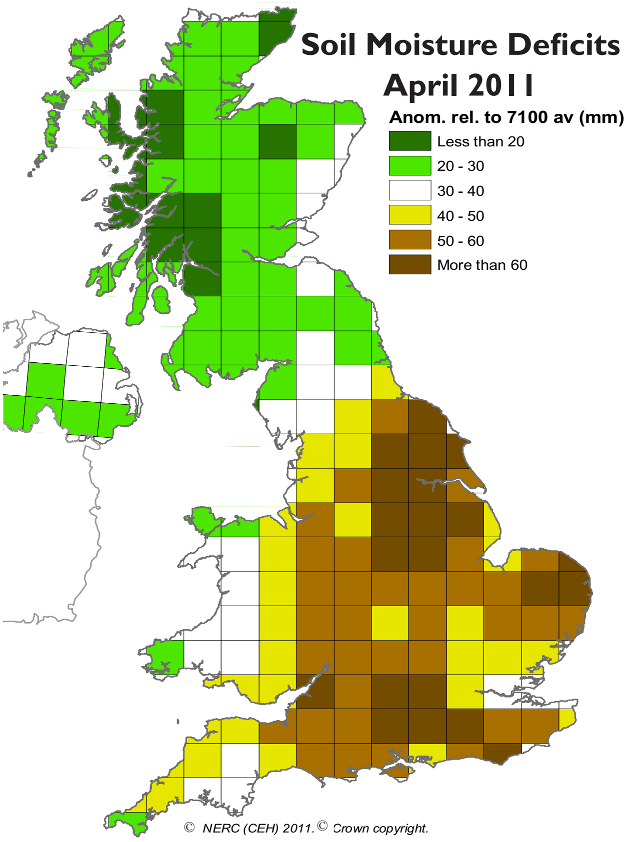
March - April 2011



December 2009 - April 2011

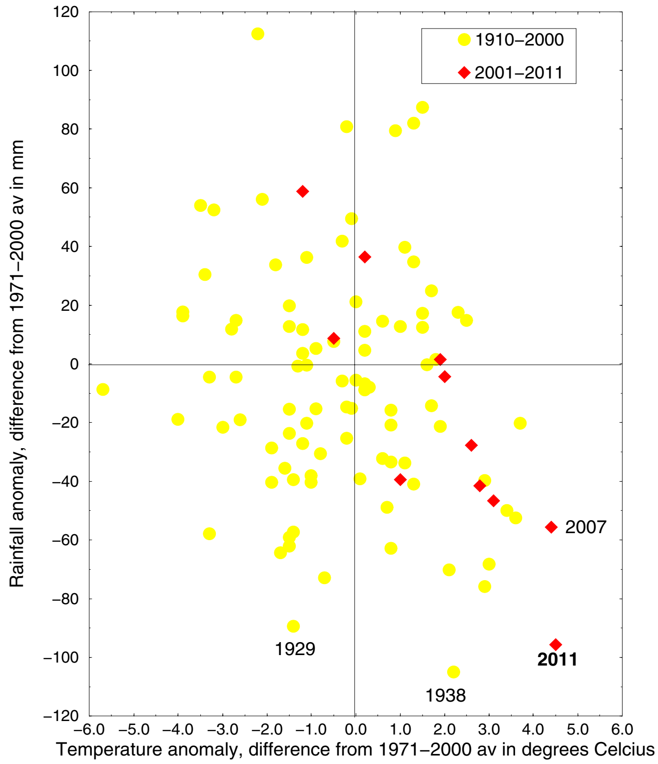


Soil Moisture Deficits April 2011



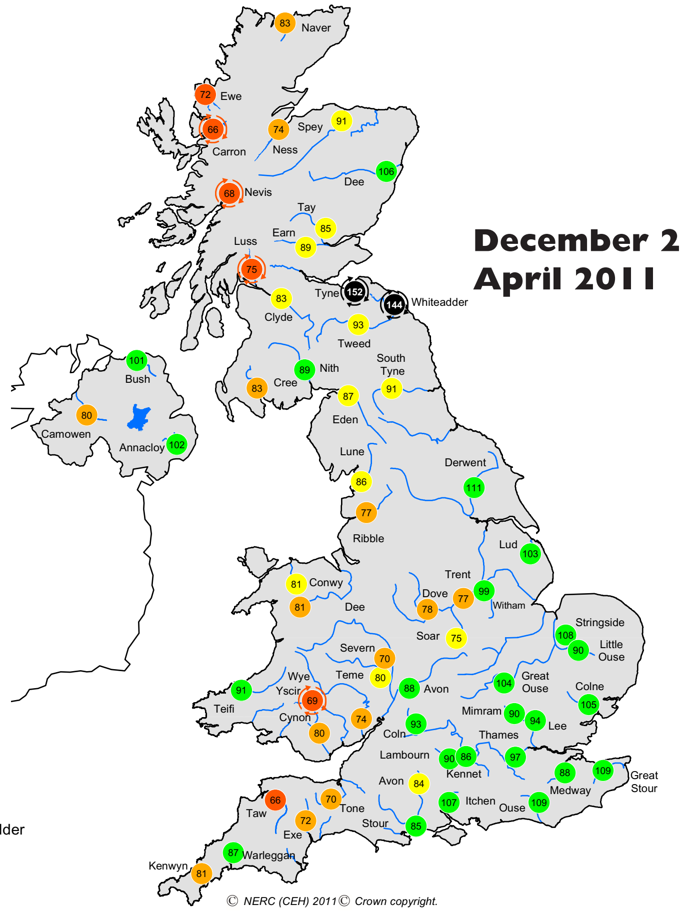
England & Wales March/April 2011

Mean temperature and rainfall anomalies (rel. to 71-00 av)

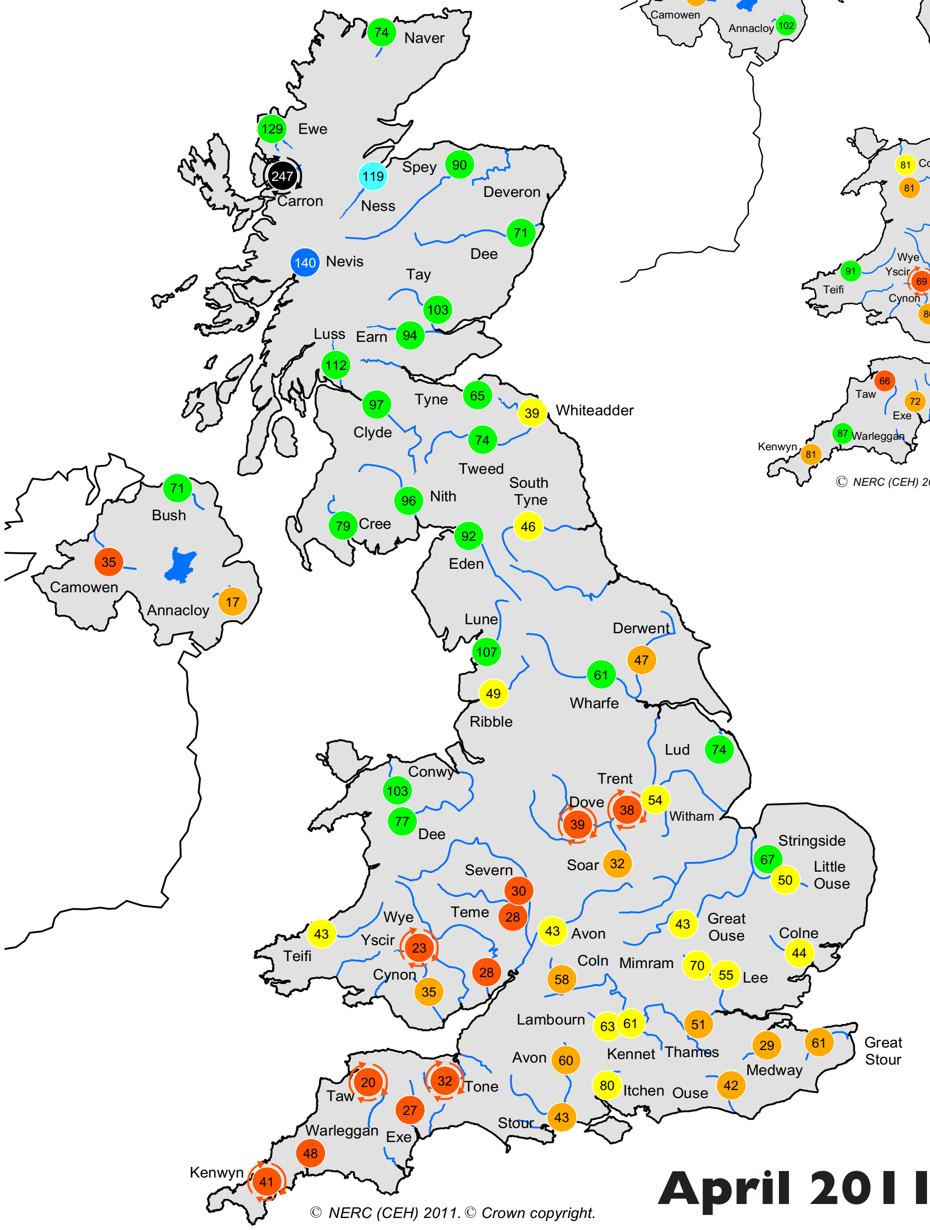


Data from Met Office: http://www.metoffice.gov.uk/climate/uk/datasets/

River flow . . . River flow . . .



December 2009 - April 2011



April 2011

Key

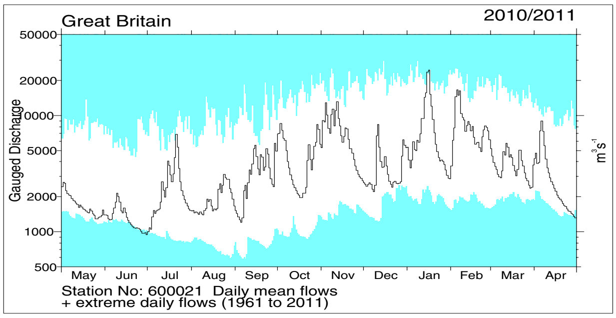
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

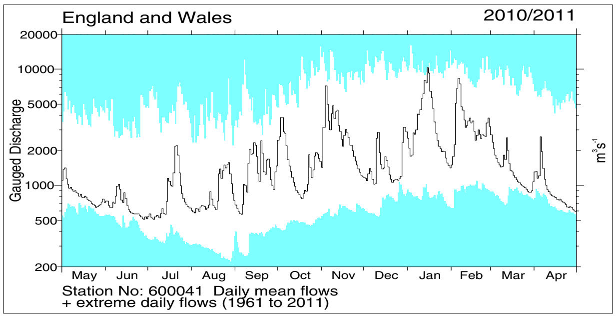
*Based on ranking of the monthly flow**

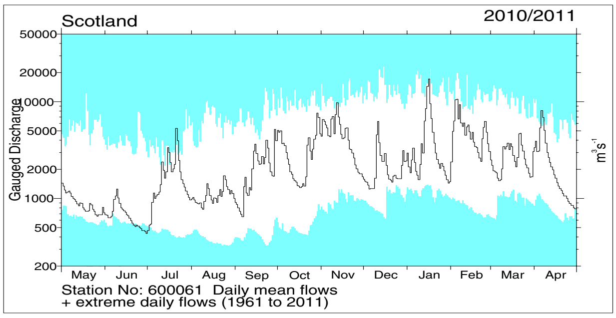
River flows

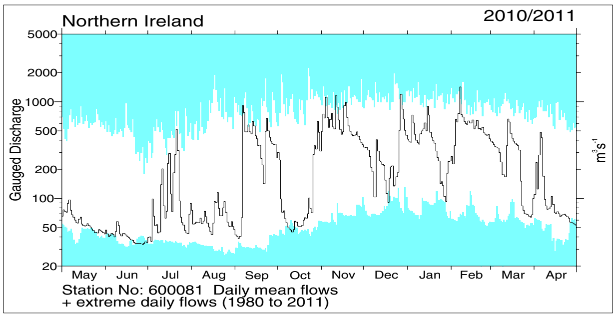
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

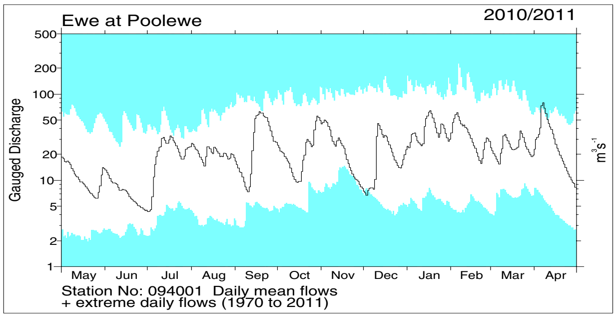
River flow . . . River flow . . .

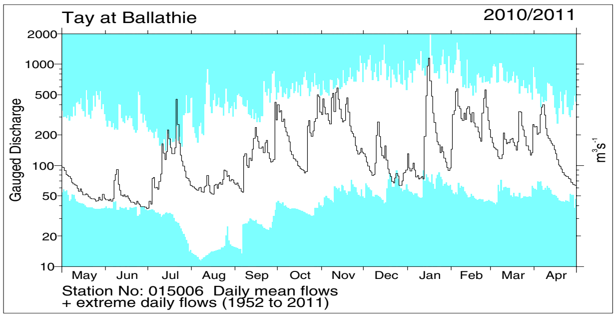


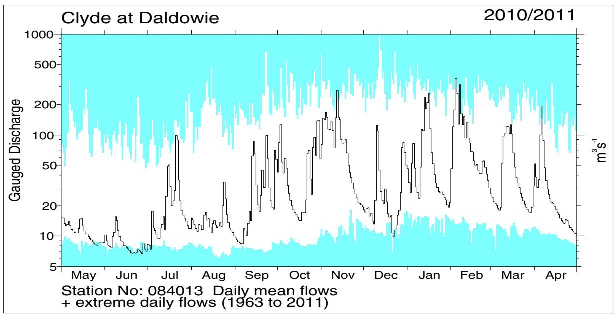


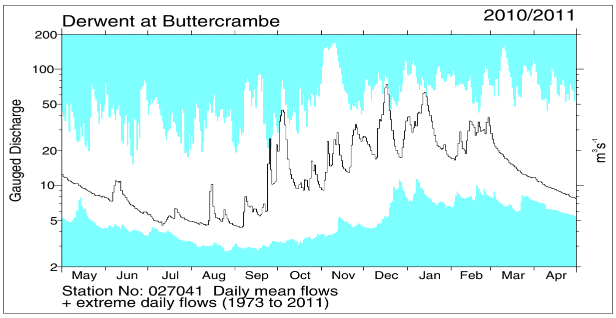


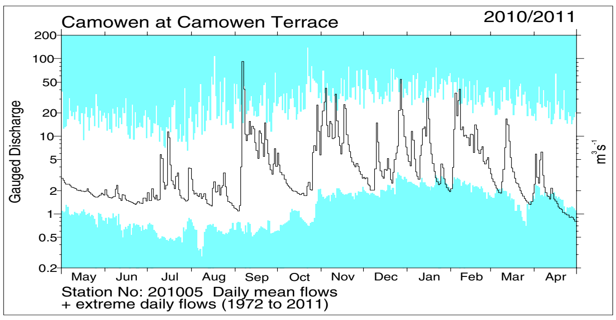


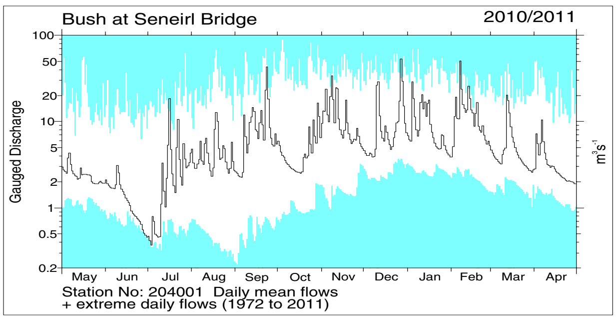








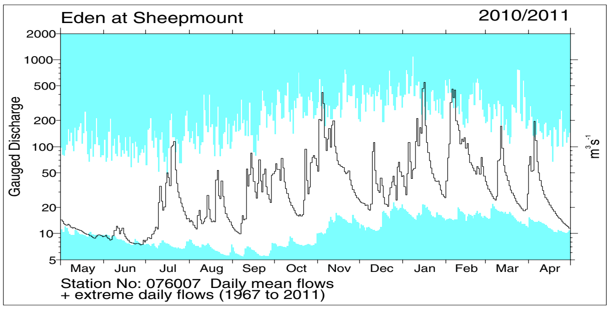


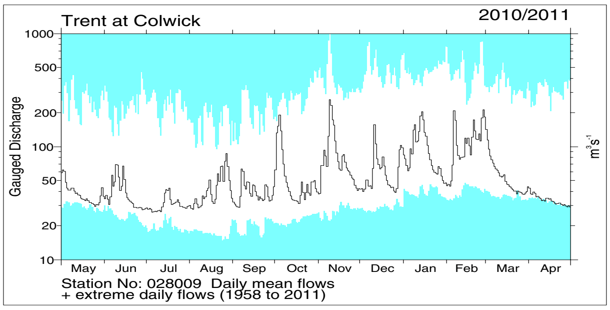


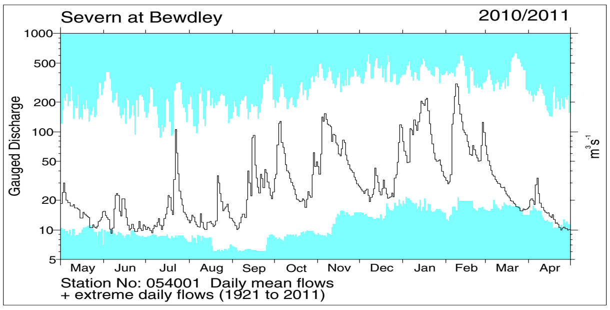
River flow hydrographs

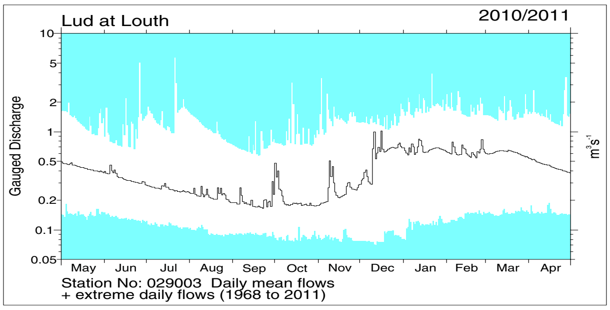
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to May 2010 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

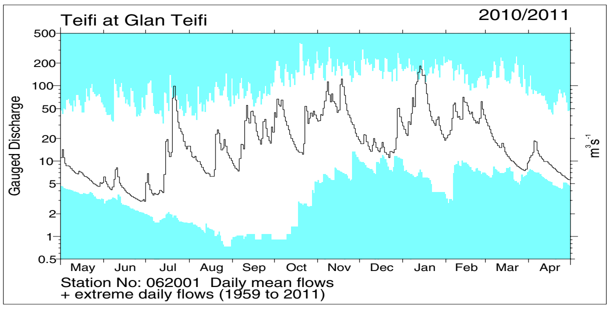
River flow . . . River flow . . .

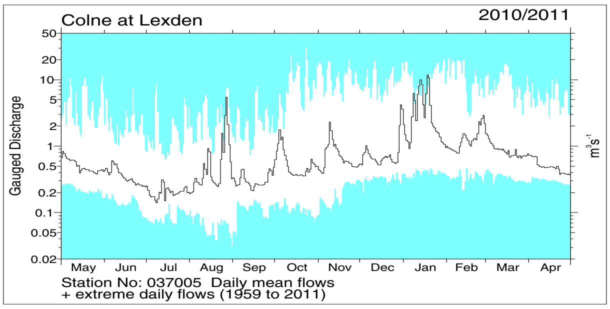


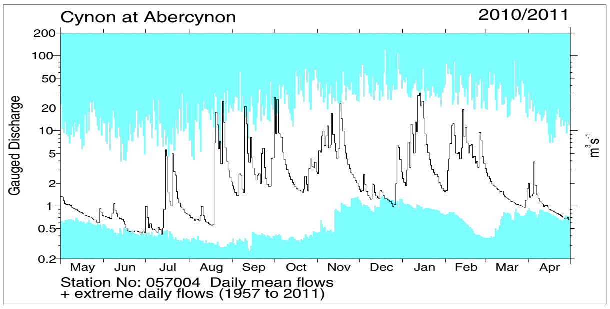


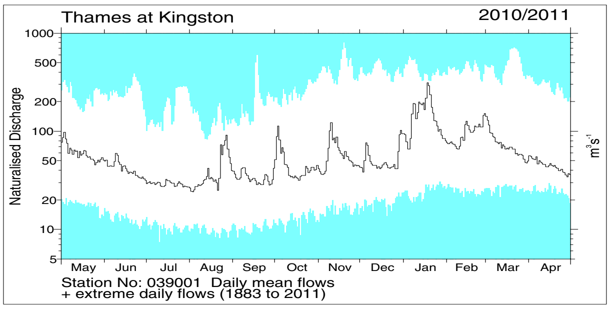


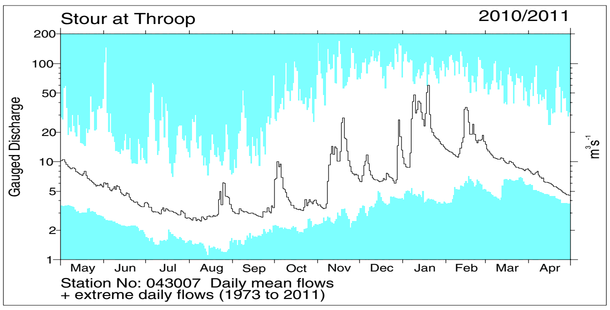


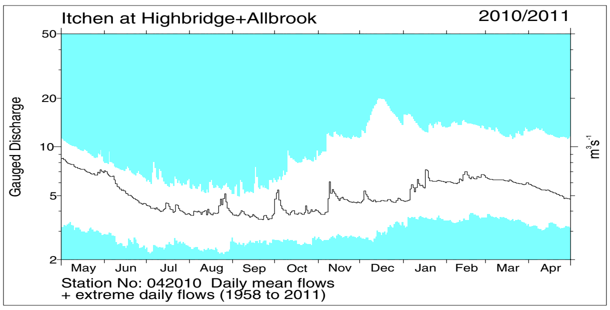












Notable runoff accumulations (a) Mar 2011 - Apr 2011 (b) Dec 2009 -Apr 2011

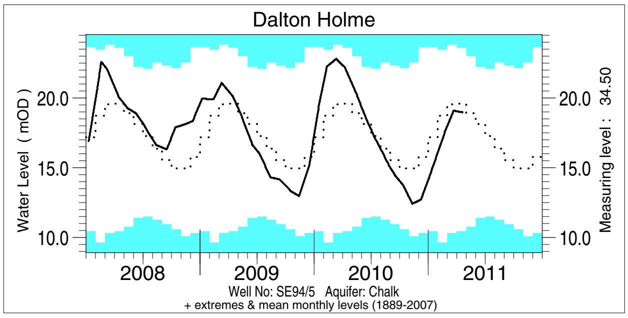
	River	%lta	Rank
a)	Trent	47	2/53
	Dove	49	1/50
	Mole	38	1/37
	Medway	34	2/53
	Exe	37	1/55
	Otter	49	1/49
	Dart	44	1/53
	Warleggan	59	2/42
	Taw	28	1/53
	Tone	38	1/51

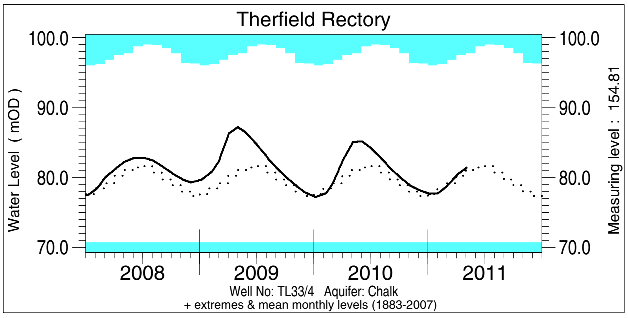
	River	%lta	Rank
a)	Brue	36	1/47
	Severn	35	2/90
	Teme	40	2/41
	Yscir	28	1/39
	Tywi	41	2/53
	Dee (New Inn)	45	2/42
	Ribble	41	2/51
	Camowen	40	1/39
	Annacloy	38	1/32

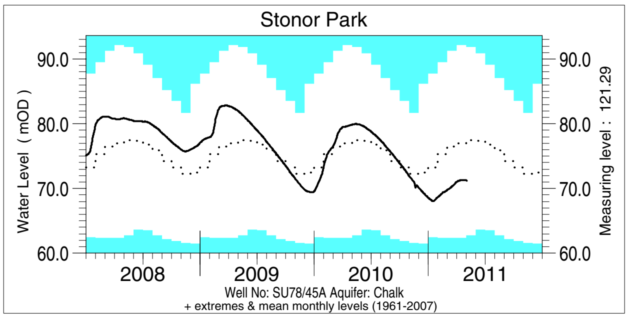
	River	%lta	Rank
b)	Forth	74	2/29
	Tyne (Spilmersford)	152	44/44
	Whiteadder	144	41/41
	Yscir	69	1/37
	Luss	75	1/30
	Nevis	68	1/28
	Carron	66	1/31
	Ewe	72	2/40

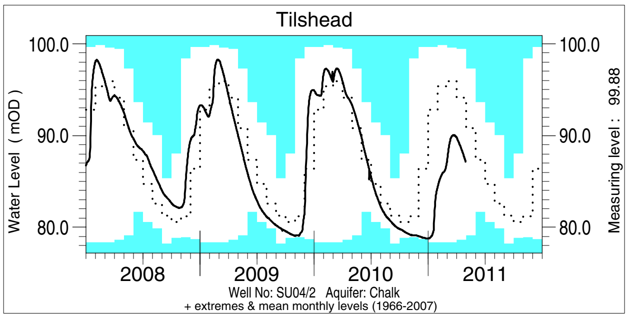
lta = long term average
Rank 1 = lowest on record

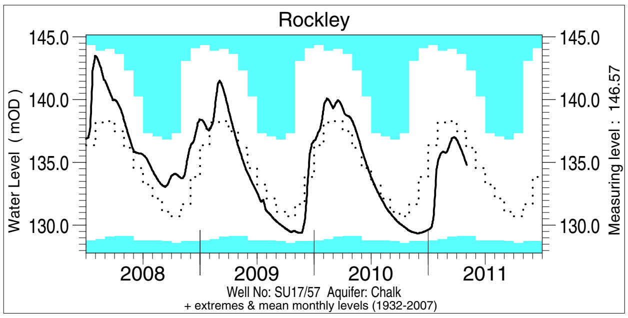
Groundwater . . . Groundwater

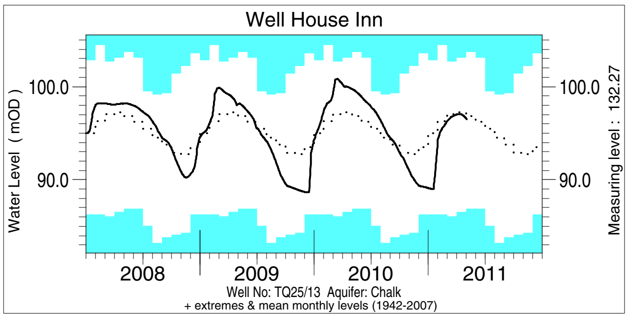


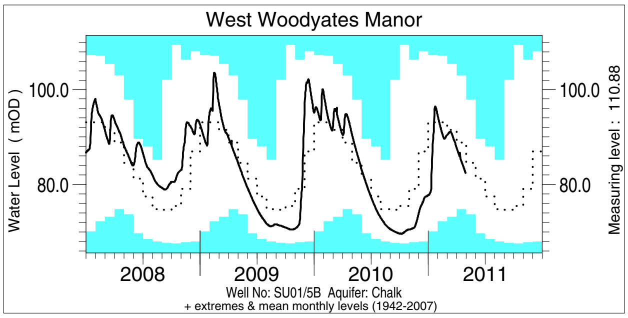


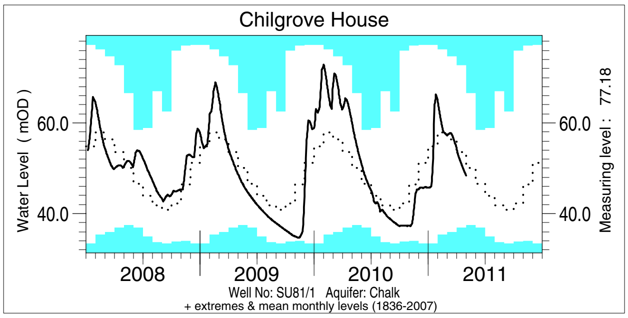


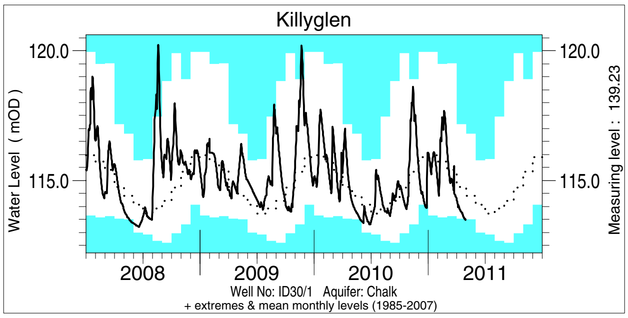


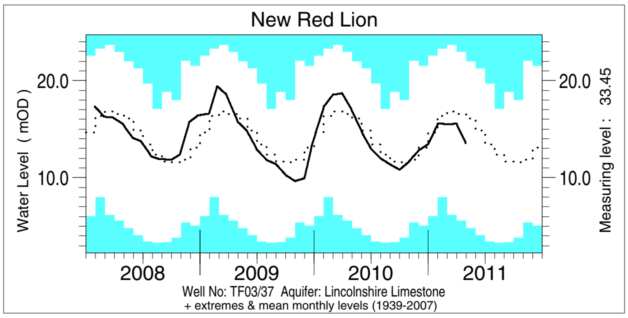






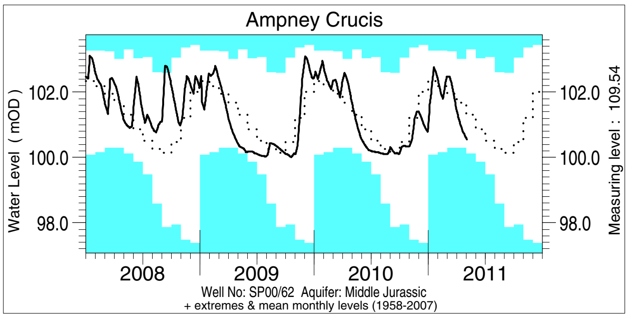


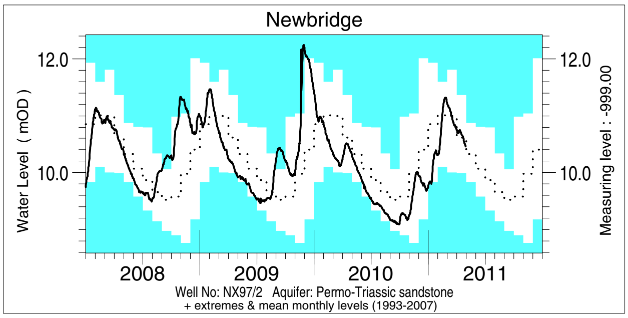


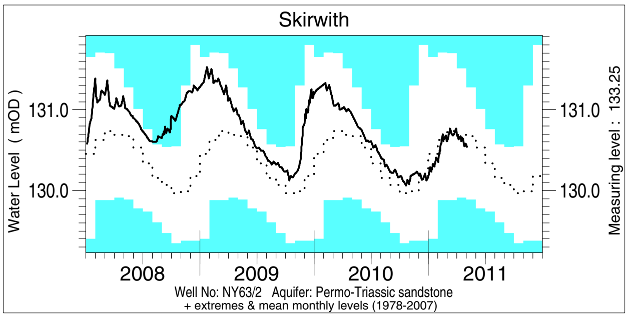


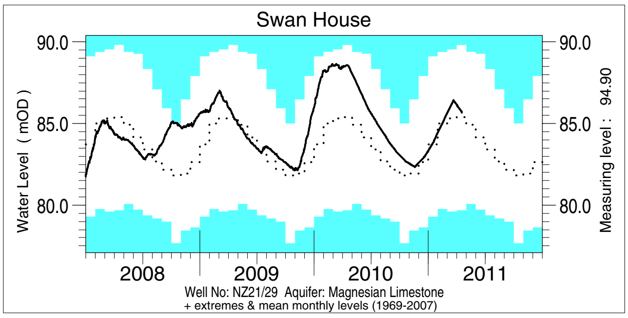
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

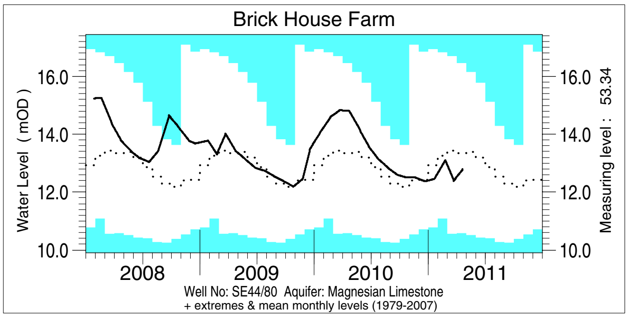
Groundwater . . . Groundwater

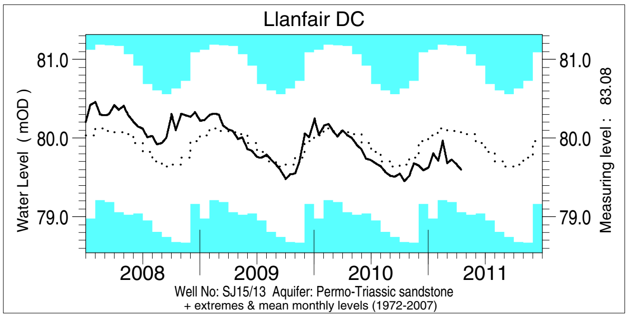


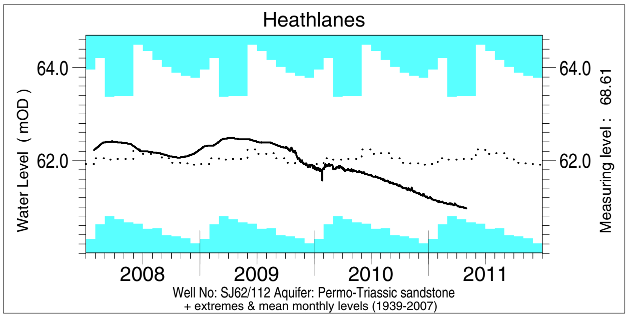


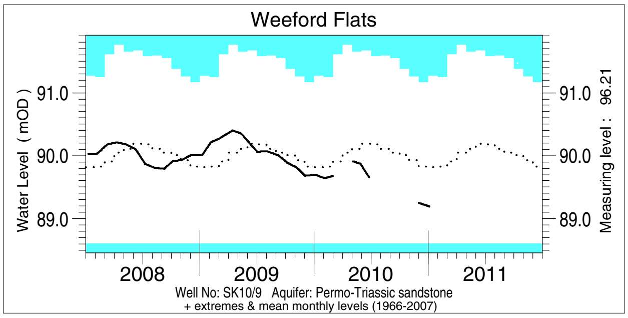


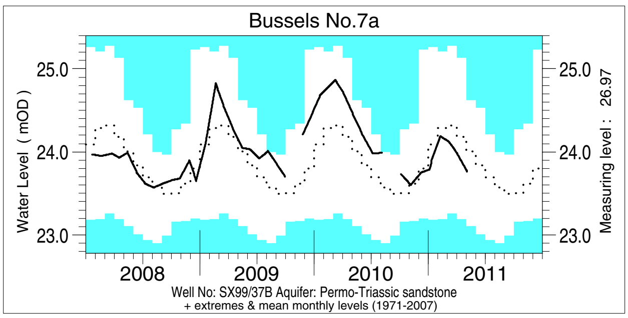


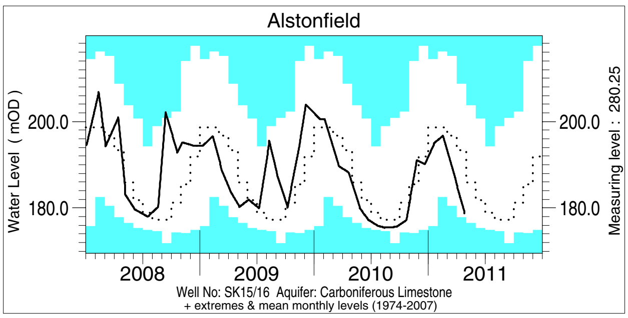










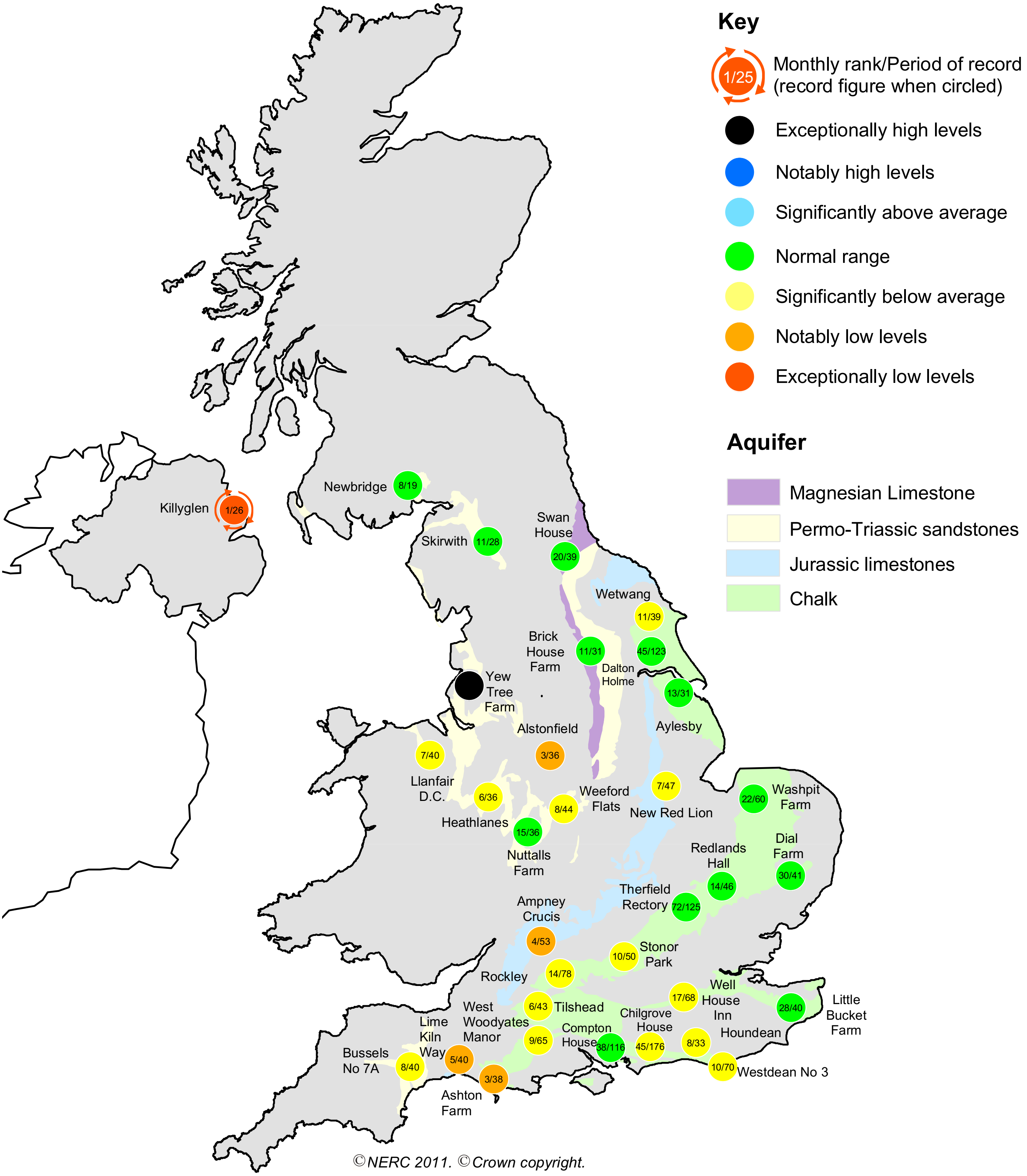


Groundwater levels April / May 2011

Borehole	Level	Date	Apr av.	Borehole	Level	Date	Apr. av.	Borehole	Level	Date	Apr. av.
Dalton Holme	18.97	20/04	19.51	Chilgrove House	48.44	01/05	52.30	Brick House Farm	12.79	20/04	13.39
Therfield Rectory	81.39	04/05	80.65	Killyglen (NI)	113.49	30/04	114.93	Llanfair DC	79.60	15/04	80.06
Stonor Park	71.24	03/05	77.63	New Red Lion	13.56	30/04	16.34	Heathlanes	60.97	01/05	62.05
Tilshead	87.17	30/04	92.72	Ampney Crucis	100.56	03/05	101.71	Weeford Flats	89.03	28/04	89.87
Rockley	134.82	03/05	137.56	Newbridge	10.46	30/04	10.53	Bussels No.7a	23.76	04/05	24.18
Well House Inn	96.52	03/05	97.19	Skirwith	130.55	04/05	130.68	Alstonfield	178.81	26/04	192.92
West Woodyates	82.40	30/04	88.48	Swan House	85.68	18/04	85.39				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



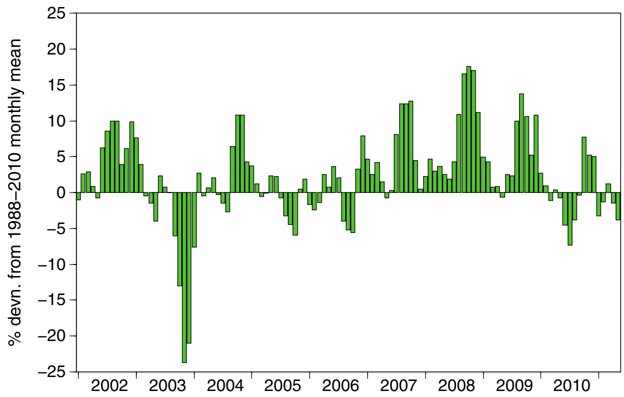
Groundwater levels - April 2011

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.

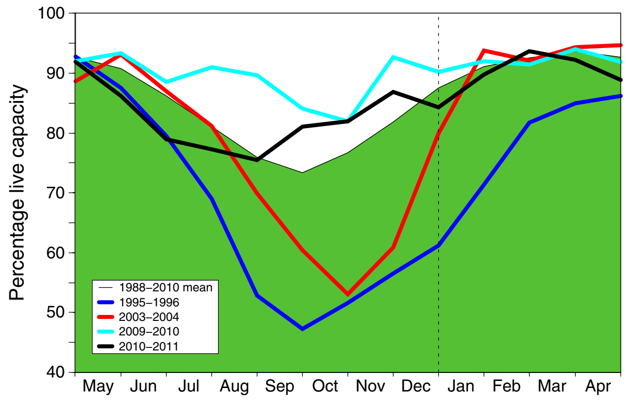
Notes:
i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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)	2011 Mar	Apr	May	May Anom.	Min May	Year* of min	2010 May	Diff 11-10
North West	N Command Zone	•	124929	97	91	**86**	-3	74	2003	82	4
	Vyrnwy		55146	100	92	**87**	-5	70	1996	90	-3
Northumbrian	Teesdale	•	87936	93	92	**88**	-3	74	2003	85	3
	Kielder		(199175)	(91)	(91)	**(90)**	-1	(85)	1990	(88)	2
Severn Trent	Clywedog		44922	94	96	**97**	0	85	1988	96	1
	Derwent Valley	•	39525	100	89	**77**	-16	54	1996	94	-17
Yorkshire	Washburn	•	22035	98	89	**80**	-10	76	1996	87	-7
	Bradford supply	•	41407	100	92	**83**	-8	60	1996	89	-6
Anglian	Grafham		(55490)	(84)	(90)	**(90)**	-4	(73)	1997	(93)	-3
	Rutland		(116580)	(87)	(90)	**(89)**	-3	(72)	1997	(92)	-3
Thames	London	•	202828	92	94	**96**	2	86	1990	93	3
	Farmoor	•	13822	76	95	**100**	3	81	2000	97	3
Southern	Bewl		28170	99	98	**92**	2	63	1990	100	-8
	Ardingly		4685	100	100	**99**	-1	98	2005	100	-1
Wessex	Clatworthy		5364	97	92	**84**	-9	81	1990	99	-15
	Bristol WW	•	(38666)	(82)	(85)	**(83)**	-10	(83)	2011	(95)	-12
South West	Colliford		28540	87	87	**82**	-5	56	1997	99	-17
	Roadford		34500	79	77	**74**	-12	41	1996	92	-18
	Wimbleball		21320	93	91	**84**	-11	79	1992	98	-14
	Stithians		4967	100	98	**88**	-3	65	1992	95	-7
Welsh	Celyn and Brenig	•	131155	100	98	**96**	-2	75	1996	99	-3
	Brianne		62140	98	94	**89**	-8	86	1997	97	-8
	Big Five	•	69762	100	94	**85**	-8	85	2011	93	-8
	Elan Valley	•	99106	100	94	**83**	-14	83	2011	94	-11
Scotland(E)	Edinburgh/Mid Lothian	•	97639	97	96	**93**	0	62	1998	97	-4
	East Lothian	•	10206	100	100	**99**	1	89	1992	100	-1
Scotland(W)	Loch Katrine	•	111363	93	91	**85**	-7	80	2010	80	5
	Daer		22412	99	97	**96**	0	87	2007	97	-1
	Loch Thom	•	11840	95	96	**96**	2	83	2010	83	13
Northern Ireland	Total+	•	56920	96	91	**83**	-5	77	2007	92	-9
	Silent Valley	•	20634	99	90	**80**	-3	58	2000	91	-11

() 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 1988-2010 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.

[#] Instigated in 1988
[*]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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Selected text and maps are available on the WWW at http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html
Navigate via Hydrological Summary for the UK.

05/11