Hydrological Summary

for the United Kingdom

March 2011

General

Rainfall patterns in March can be pivotal in relation to the water resources outlook: with evaporation accelerating through the spring an exceptionally dry month may signal the end of the aquifer recharge season and an early onset in the seasonal decline of reservoir stocks. This March was, provisionally, the driest since 1961 for England & Wales with very meagre rainfall totals in many central, southern and eastern areas – contributing to substantial accumulated deficiencies over periods of up to 16 months. Reservoir stocks increased through March in a number of major impoundments in the English Lowlands but elsewhere, and contrary to the normal pattern, stocks in many reservoirs fell appreciably. Early April stocks were the lowest since 1996 for England & Wales as a whole with the most notable anomalies in south west England. Nonetheless, stocks were within 10% of the early April average, and appreciably above drought minima, in all index reservoirs/reservoir groups across the UK (greater depletions would be expected for smaller reservoirs e.g. those servicing agricultural needs). Spate conditions were a feature of some northern rivers in mid-March but sustained recessions leading to exceptionally low late-March flows typified many responsive rivers. Soil moisture deficits increased briskly particularly across the English Lowlands and infiltration during March was minimal in most aquifer outcrop areas. Correspondingly, groundwater levels are mostly below average but generally remain considerably above the corresponding levels during the protracted groundwater droughts of the 1990s. In general terms, water resources are resilient to the current scale of long term rainfall deficiencies but a dry late spring would increase the stress on resources and herald exceptionally depressed river flows during the summer. Careful monitoring will be needed to index any significant intensification of the nascent drought conditions over the coming weeks.

Rainfall

Synoptic patterns across southern Britain during March were dominated by sustained high pressure with most active low pressure systems following more northerly tracks. Significant frontal rainfall was recorded in parts of Scotland (e.g. 38mm at Kinlochewe on the 8th and 35mm at Cluanie Inn on the 10th) and snowfall contributed to above average March precipitation totals in much of eastern and central Scotland. To the south however the rainfall gradient was steep: large parts of southern Britain registered less than a quarter of the average March rainfall with lengthy sequences of dry days across central and southern England. March totals fell below 2mm in a few localities in Cambridgeshire. More significantly from a water resources perspective was the very limited rainfall over the winter half-year. Oct-Mar precipitation totals across most of southern Britain were >20% below average; for Wales and the Midland region it was the driest in this timeframe since the extreme drought of 1975/76. In much of the country rainfall deficiencies began to build as far back as the late autumn of 2009. Subsequently, the relatively low frequency of Atlantic frontal systems resulted in some areas (e.g. in south west England, the Midlands and western Scotland) registering only two months with above average rainfall. For the South West region rainfall over the 16 months ending in March was, again, the lowest since 1975/76 and significant long term deficiencies extend across much of the country.

River flows

Flows during the last week of February were generally within the normal range for the late winter and spate conditions typified many northern rivers in mid-March. However the most notable hydrological characteristic of the month was the steep and sustained recessions which continued into April, by which time seasonally depressed runoff rates were very widespread. The decrease in flows was most obvious in responsive catchments. Many rivers in England, Wales and Northern Ireland (including the Trent, Taw, Dee, Ribble and Camowen) approached March minima during the last week of the month. Healthier flows earlier in the month resulted in less evidently depressed monthly runoff totals but in Wales and the South West, the Yscir, Dee and Taw each registered their 2nd lowest (after 1993) March runoff on record and almost all index rivers registered well below average March runoff. Over the winter half-year, depressed runoff totals characterise much of southern Britain, and also many west-draining catchments in northern Scotland. The paucity of maritime influences in much of western Britain is underlined by the accumulated runoff totals since November 2009: in Scotland, the Carron, Nevis and Luss have each established new period-of-record minima in this 16-month timespan (runoff was also depressed in Northern Ireland). Healthier accumulated runoff totals typify most eastern catchments, notably in parts of eastern Scotland.

Groundwater

Across most major aquifer outcrop areas, March rainfall totals were less than 20% of average; correspondingly soil moisture deficits began to build and were appreciably above average by month-end. Initial analyses suggest that recharge to the major aquifers was the lowest for March in at least 50 years and, with soils continuing to dry out in early April, this may signal the end of the 2010/11 recharge season in most eastern, southern and central aquifer areas. The lagged response to the above-average February rainfall means that only in the more responsive aquifers is the recent arid spell reflected in the March groundwater levels. Water-tables were falling in most limestone outcrop areas, in the southern Chalk, and in wells and boreholes tapping the Permo-Triassic sandstones of the Midlands and north Wales. In these areas March levels were significantly below average. In the slower-responding eastern Chalk, and some northern index wells, groundwater levels rose during March and remain generally within the normal early spring range. A relatively dry April would, very likely, extend the area where recharge has ceased and lead to an early cessation of flows in winterbournes. It would also imply a reduction in the important contribution that groundwater makes to summer river flows – particularly in the English Lowlands.

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.

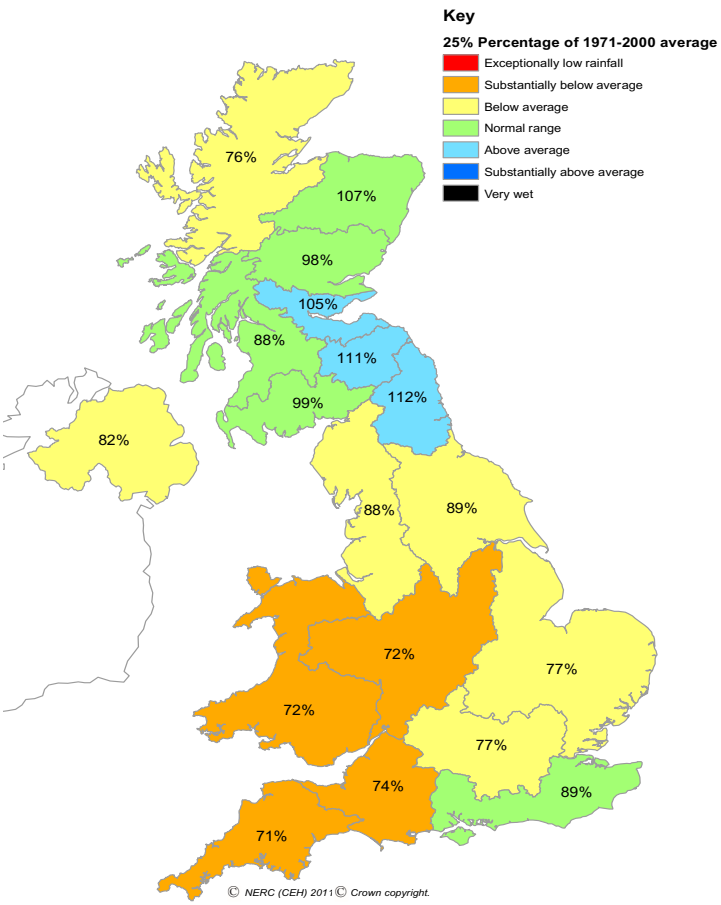
Area	Rainfall	Mar 2011	Jan11 - Mar11	RP	Oct10 - Mar11	RP	Apr10 - Mar11	RP	Dec09 - Mar11	RP
United Kingdom	mm	**49**	263		535		980		1315	
	%	**53**	89	2-5	83	5-10	90	5-10	88	5-10
England	mm	**19**	174		374		701		995	
	%	**29**	84	2-5	81	5-10	86	8-12	89	5-10
Scotland	mm	**103**	401		782		1381		1762	
	%	**78**	97	2-5	88	2-5	96	2-5	87	5-10
Wales	mm	**32**	307		619		1174		1589	
	%	**28**	82	2-5	74	12-16	86	8-12	83	14-18
Northern Ireland	mm	**54**	248		524		1033		1367	
	%	**58**	83	2-5	82	5-10	93	2-5	90	5-10
England & Wales	mm	**21**	192		407		766		1077	
	%	**29**	84	2-5	80	5-10	86	8-12	88	5-10
North West	mm	**46**	322		605		1102		1421	
	%	**46**	105	2-5	88	2-5	94	2-5	88	5-10
Northumbria	mm	**42**	216		509		850		1192	
	%	**61**	103	2-5	112	2-5	102	2-5	106	2-5
Midlands	mm	**12**	134		296		613		842	
	%	**20**	71	5-10	72	15-20	81	10-15	82	15-20
Yorkshire	mm	**13**	171		403		709		1002	
	%	**20**	83	2-5	89	2-5	87	5-10	90	5-10
Anglian	mm	**6**	103		236		524		762	
	%	**13**	76	2-5	77	5-10	87	5-10	96	2-5
Thames	mm	**11**	143		292		558		840	
	%	**21**	85	2-5	77	5-10	80	8-12	89	2-5
Southern	mm	**18**	182		403		666		1041	
	%	**31**	93	2-5	89	2-5	85	5-10	98	2-5
Wessex	mm	**22**	186		375		671		978	
	%	**31**	81	2-5	74	8-12	77	15-20	82	10-15
South West	mm	**30**	250		531		954		1374	
	%	**31**	73	2-5	71	14-18	79	15-20	81	15-20
Welsh	mm	**30**	287		584		1124		1529	
	%	**28**	80	2-5	72	15-20	85	8-12	83	12-16
Highland	mm	**114**	443		831		1517		1904	
	%	**70**	87	2-5	76	2-5	88	2-5	79	10-15
North East	mm	**88**	243		569		1097		1495	
	%	**114**	101	2-5	107	2-5	116	2-5	117	5-10
Tay	mm	**105**	388		777		1328		1672	
	%	**88**	101	2-5	98	2-5	105	2-5	93	2-5
Forth	mm	**96**	364		712		1199		1533	
	%	**93**	114	5-10	105	2-5	106	2-5	97	2-5
Tweed	mm	**66**	293		607		997		1391	
	%	**83**	117	2-5	111	2-5	104	2-5	106	2-5
Solway	mm	**93**	452		846		1419		1826	
	%	**76**	116	5-10	99	2-5	101	2-5	93	2-5
Clyde	mm	**121**	503		952		1625		2018	
	%	**75**	100	<2	88	2-5	94	2-5	83	5-10

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

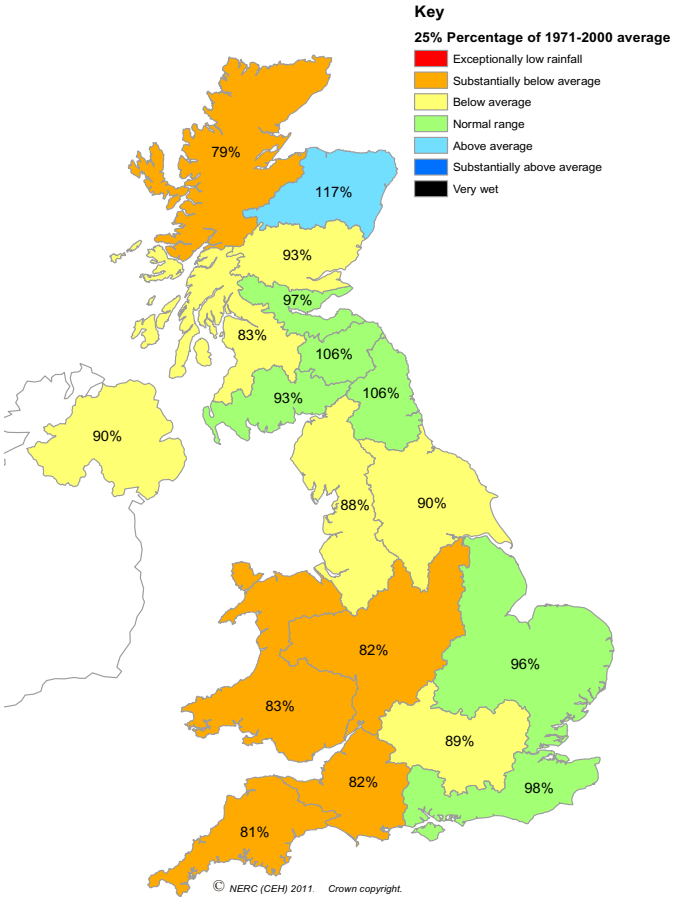
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

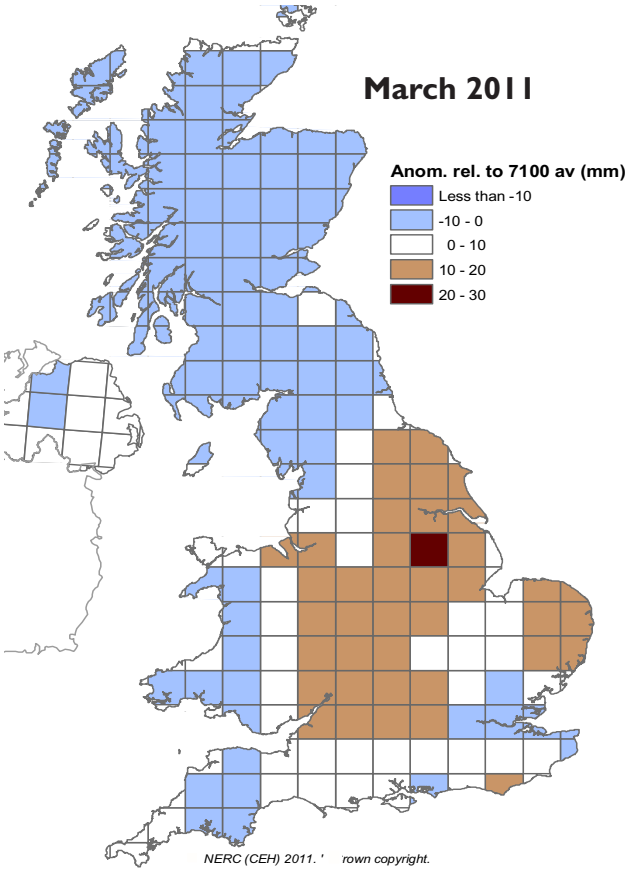
October 2010 - March 2011



December 2009 - March 2011



March 2011



Met Office Weather forecast

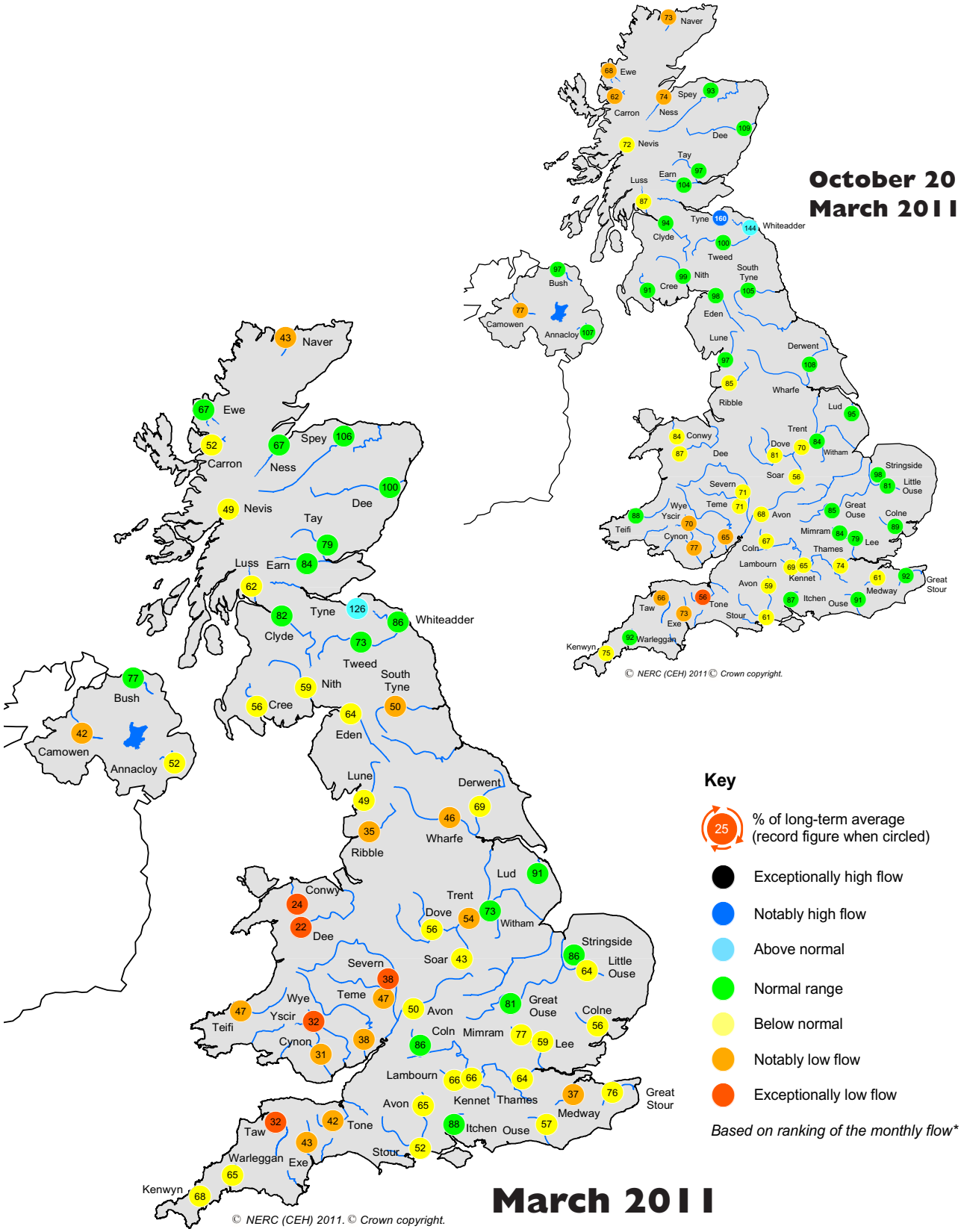
Updated: 12:59 on Wednesday 13 April 2011

UK Outlook for Mon 18 Apr to Weds 27 Apr 2011:
The mostly settled and generally dry theme looks set to continue for many areas, with variable amounts of cloud and some sunny spells. Winds are likely to be fairly light for most places, however it will be breezy at times in the south and west, particularly at first. Also, temperatures will be around or above average for mid to late April across much of the UK, with some warm days likely. However, there is a chance of outbreaks of rain spreading into western parts of the UK, especially southwestern parts of England and Wales. Any rain that does spread into western areas is unlikely to make much eastwards progress, with most east and particularly northeastern parts of the UK remaining dry.

UK Outlook for Thurs 28 Apr to Thurs 12 May 2011:
It will be a settled start for most areas, with a good deal of fine and dry weather. Temperatures will be above average for most and winds will remain generally light. However, the chance of more unsettled conditions spreading into western parts will continue. As the period progresses through May there is an increasing signal for conditions to become more generally unsettled, with outbreaks of rain and occasionally strong winds reaching most parts.

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

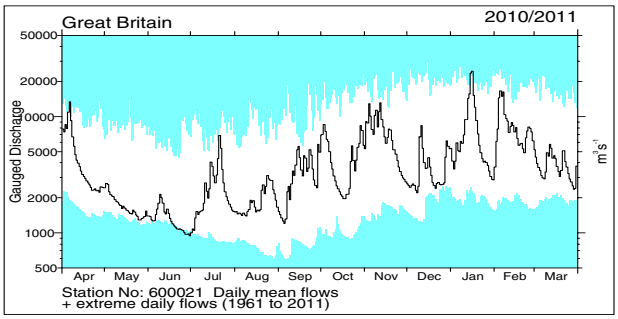
River flow . . . River flow . . .

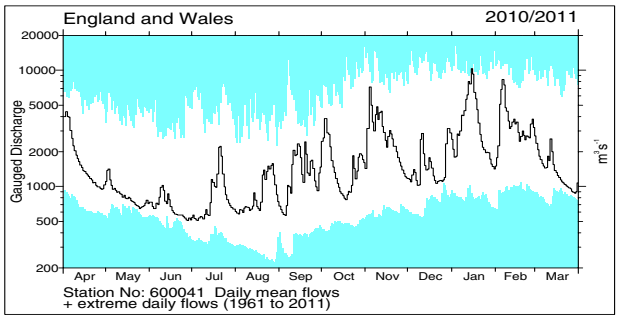


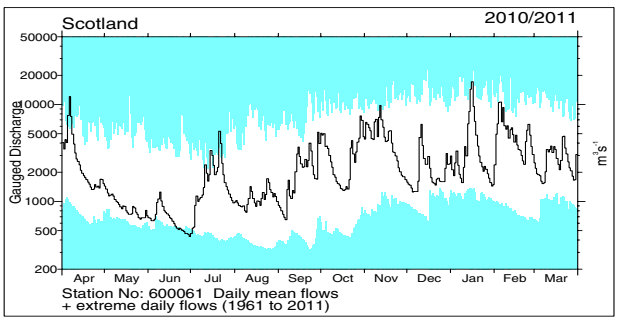
River flows

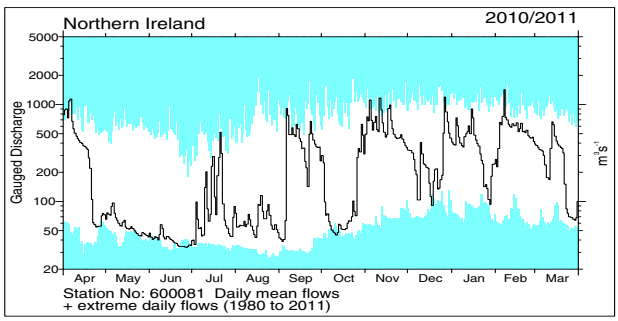
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

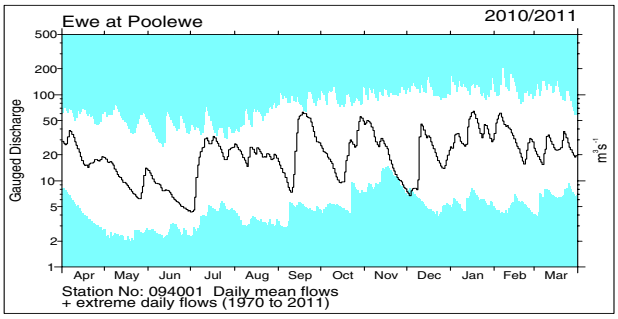
River flow . . . River flow . . .

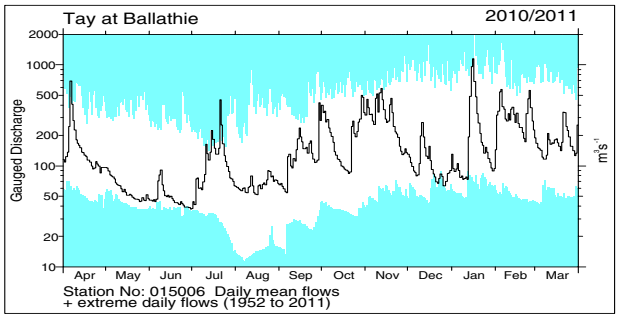


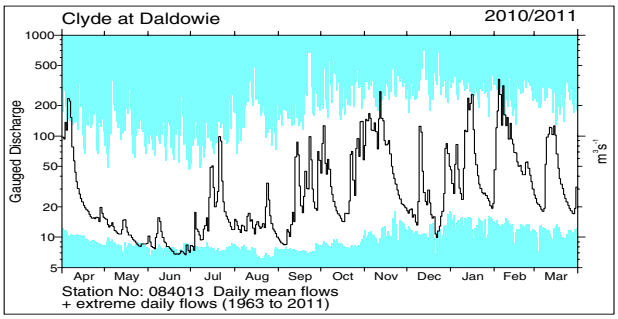


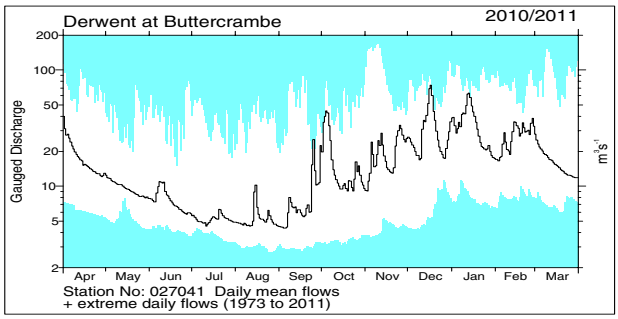


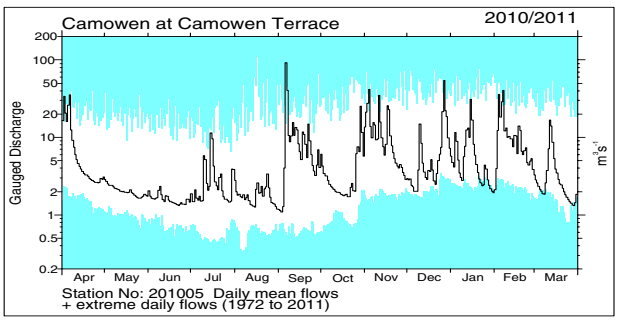


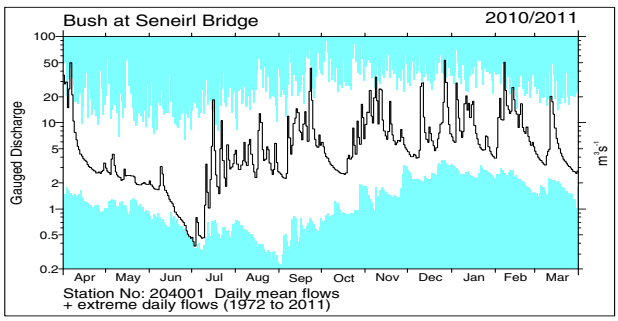








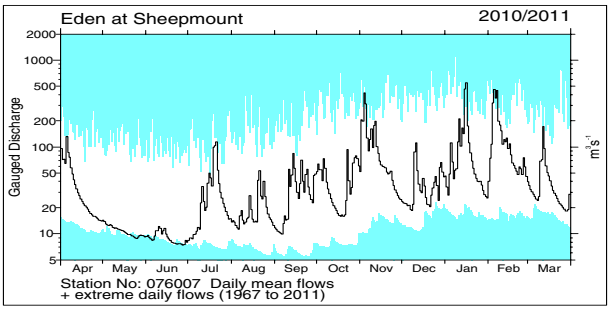


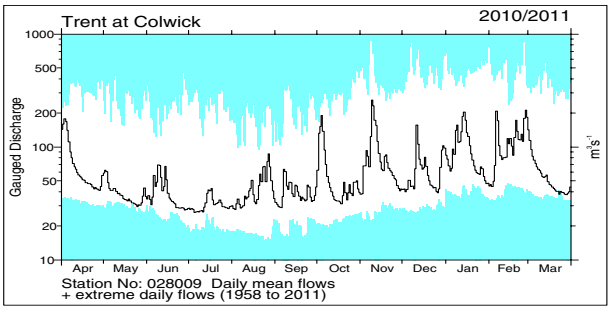


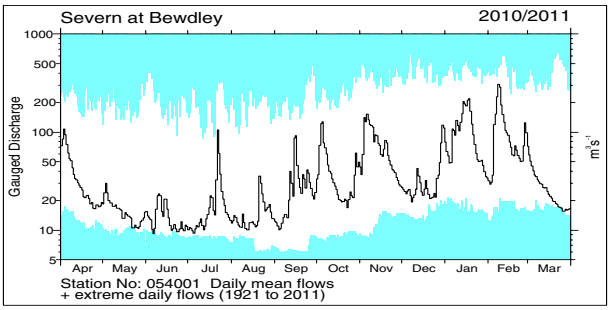
River flow hydrographs

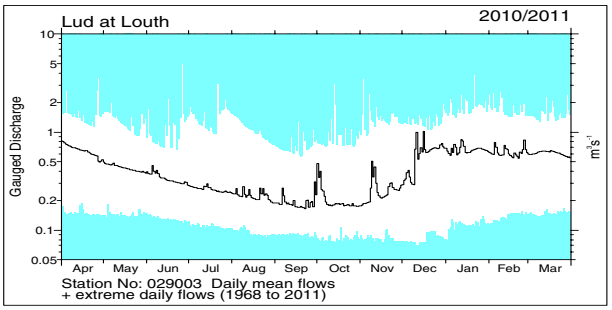
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2010 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

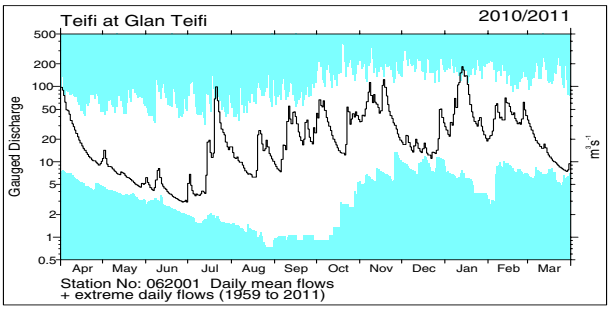
River flow . . . River flow . . .

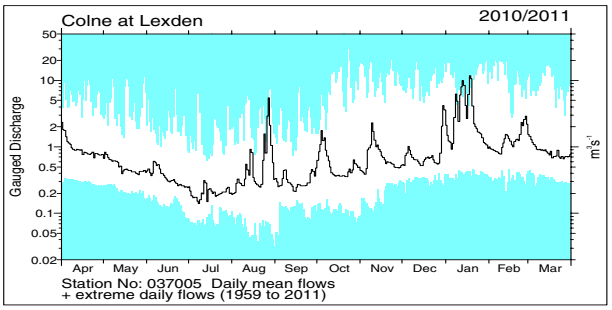


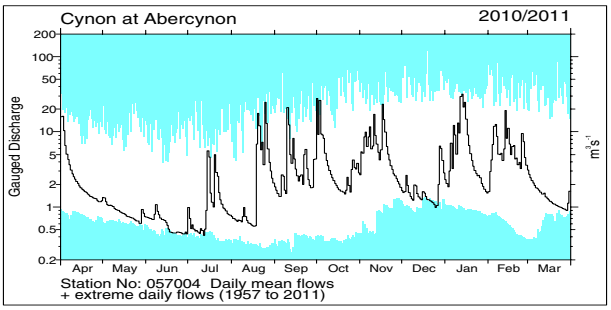


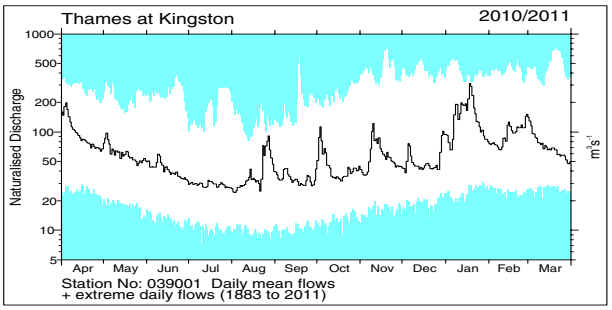


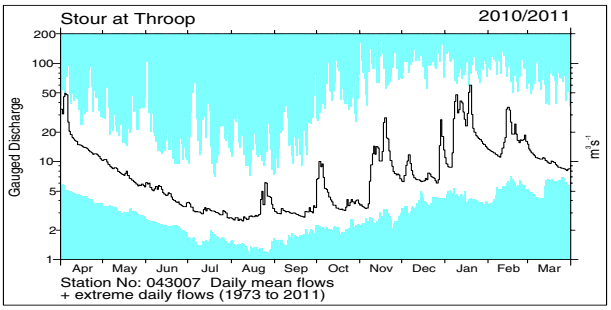


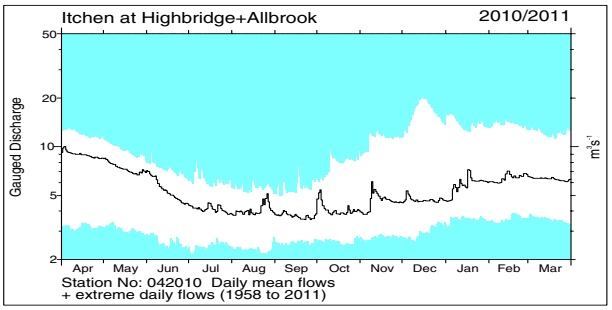












Notable runoff accumulations (a) Oct 2010 - Mar 2011 (b) Dec 2009 -Mar 2011

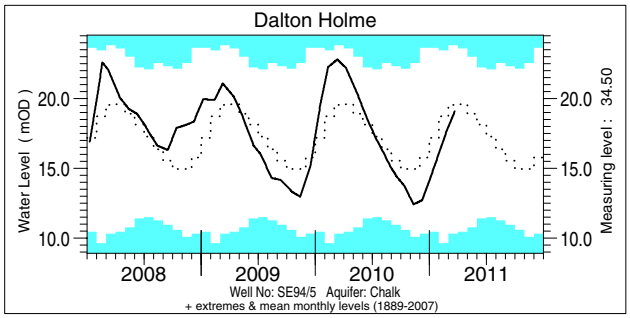
	River	%lta	Rank
a)	Tone	56	2/50
	Brue	58	3/45
	Teme	71	6/41
	Wye (Redbrook)	65	7/75
	Yscir	70	2/38
	Naver	73	4/34

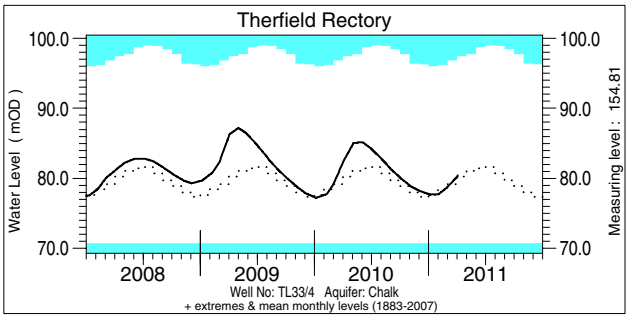
	River	%lta	Rank
b)	Ness	71	3/37
	Forth	72	2/29
	Tyne (Spilmersford)	157	44/44
	Whiteadder	151	41/41
	Exe	74	3/54
	Taw	68	2/52
	Dee (New Inn)	81	5/41

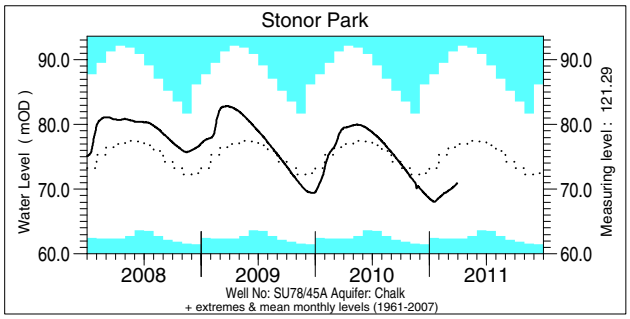
b)	River	%lta	Rank
	Luss	74	1/30
	Nevis	65	1/28
	Carron	59	1/31
	Ewe	70	2/40
	Camowen	82	2/36
	Mourne	84	4/28
	Faughan	80	4/34

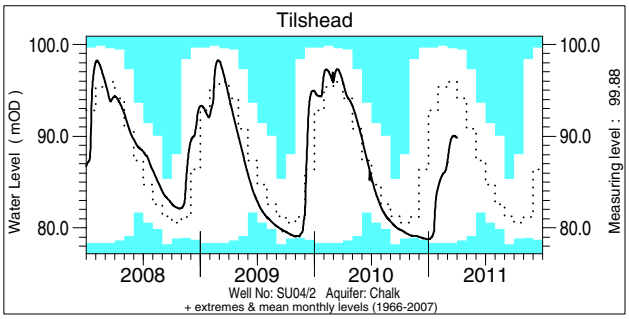
lta = long term average
Rank 1 = lowest on record

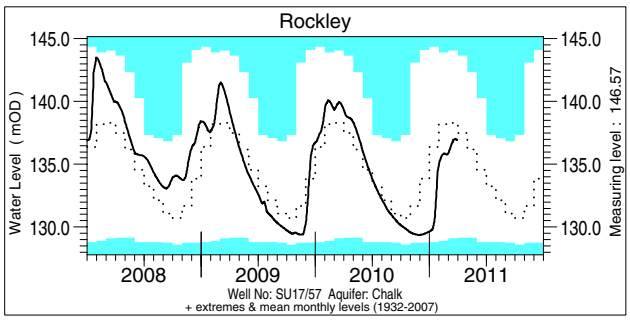
Groundwater . . . Groundwater

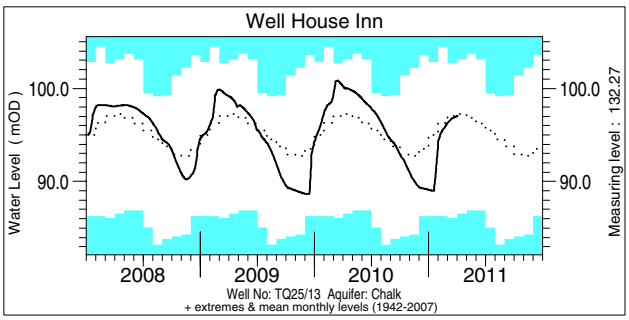


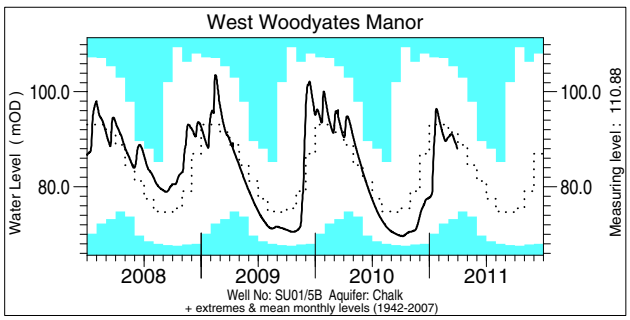


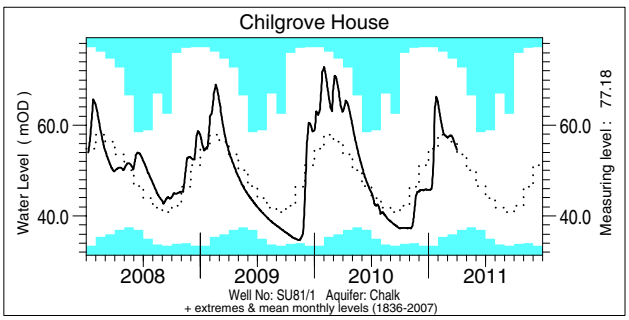


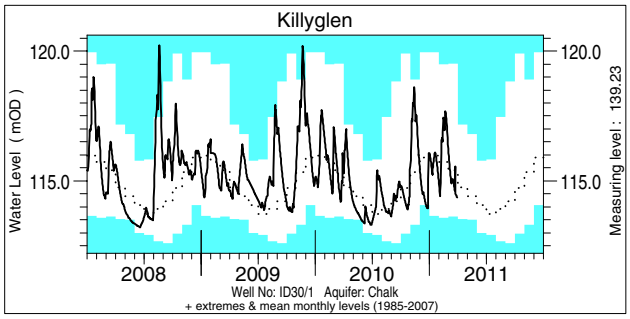


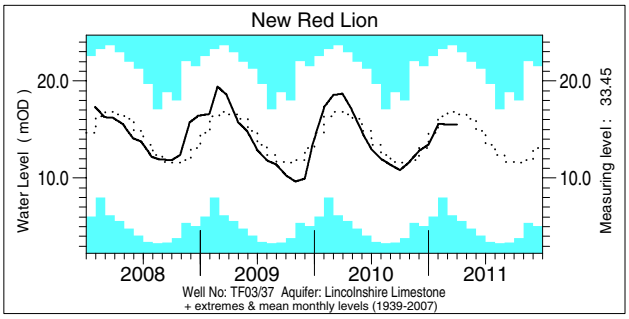






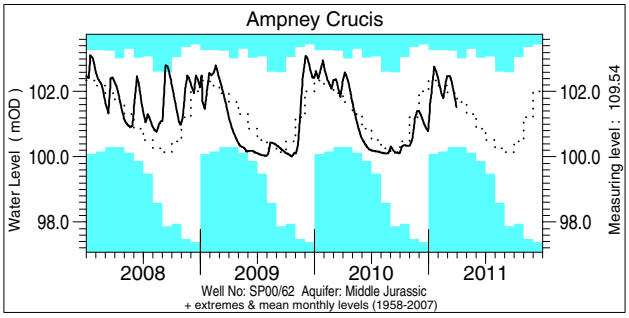


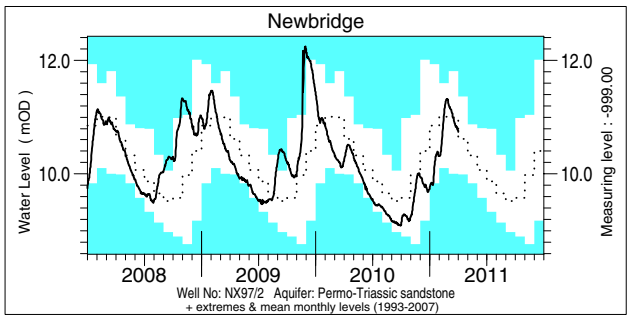


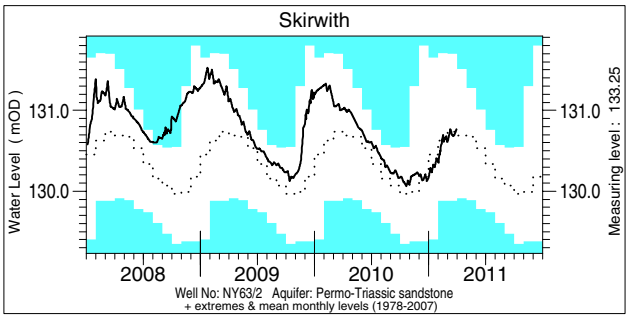


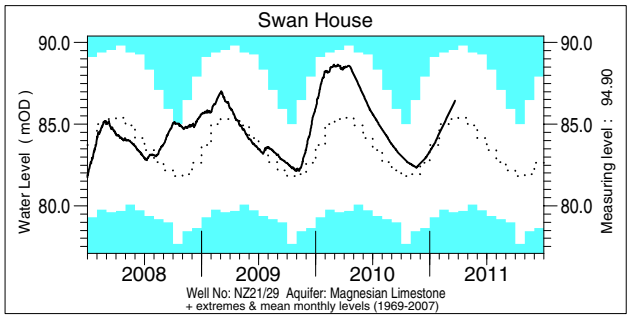
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

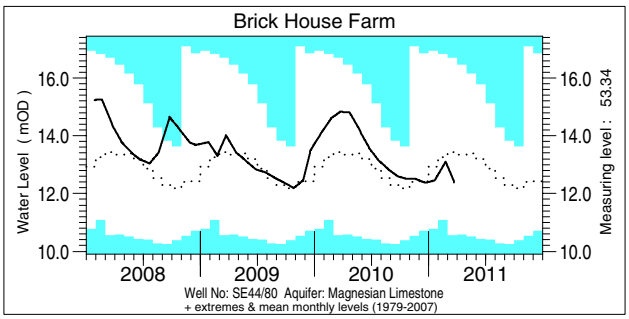
Groundwater . . . Groundwater

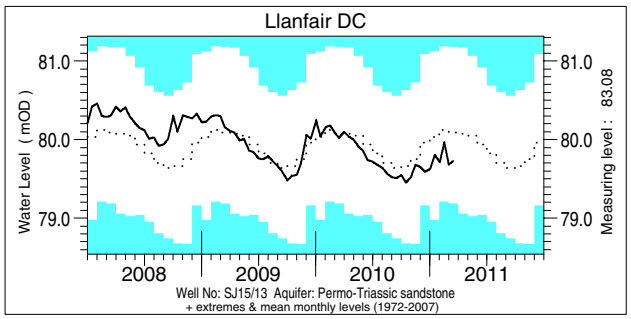


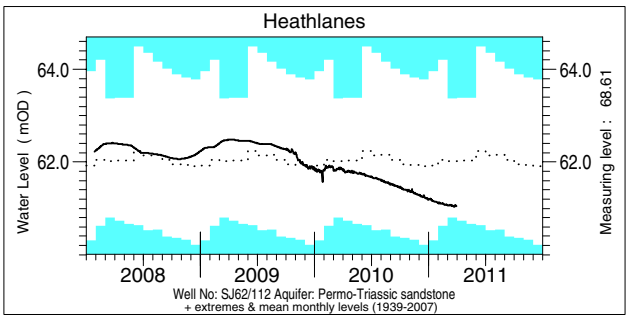


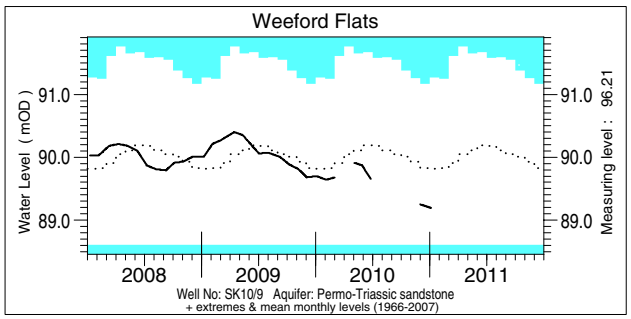


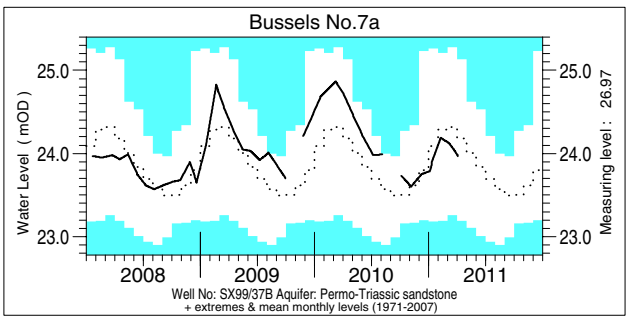


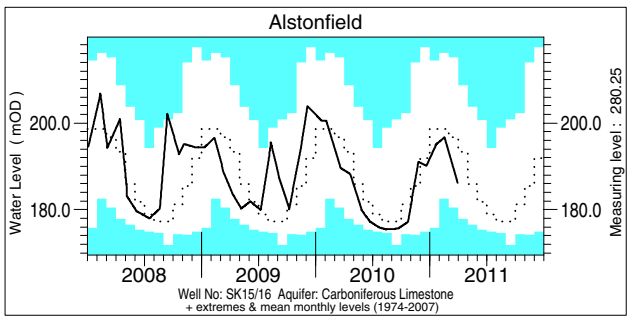








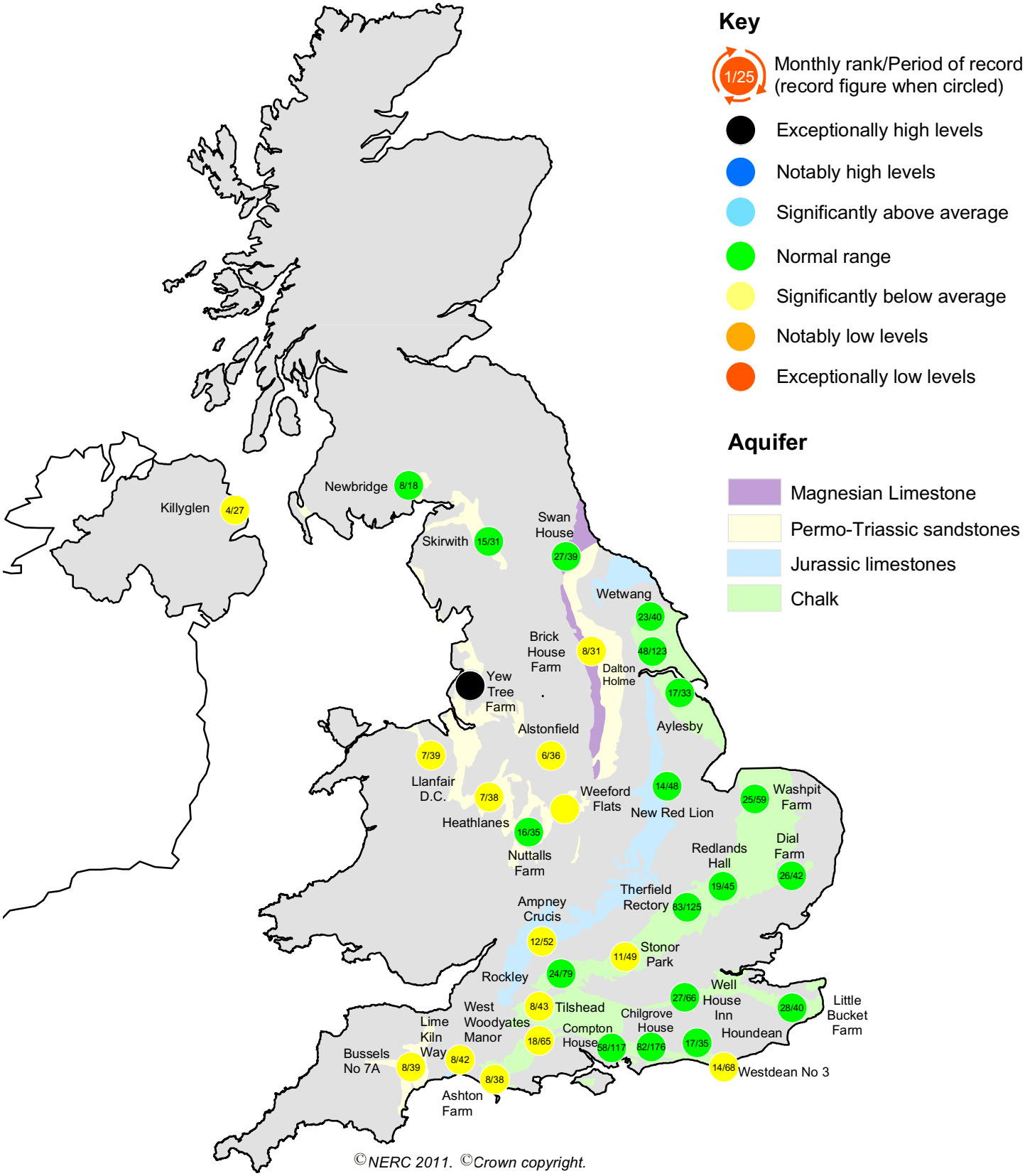




Groundwater levels March / April 2011

Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.
Dalton Holme	19.09	21/03	19.51	Chilgrove House	54.52	31/03	55.59	Brick House Farm	12.39	22/03	13.41
Therfield Rectory	80.42	04/04	79.32	Killyglen (NI)	114.36	31/03	115.48	Llanfair DC	79.73	15/03	80.07
Stonor Park	70.95	30/03	76.83	New Red Lion	15.53	31/03	16.71	Heathlanes	61.05	31/03	62.00
Tilshead	89.82	31/03	94.11	Ampney Crucis	101.52	30/03	102.00	Weeford Flats	89.19	04/01	89.77
Rockley	136.93	30/03	138.49	Newbridge	10.74	01/04	10.81	Bussels No.7a	23.97	04/04	24.33
Well House Inn	97.03	04/04	96.98	Skirwith	130.77	31/03	130.72	Alstonfield	186.13	29/03	196.01
West Woodyates	88.03	31/03	90.81	Swan House	86.43	21/03	85.43	*Levels in metres above Ordnance Datum*			

Groundwater . . .Groundwater



Groundwater levels - March 2011

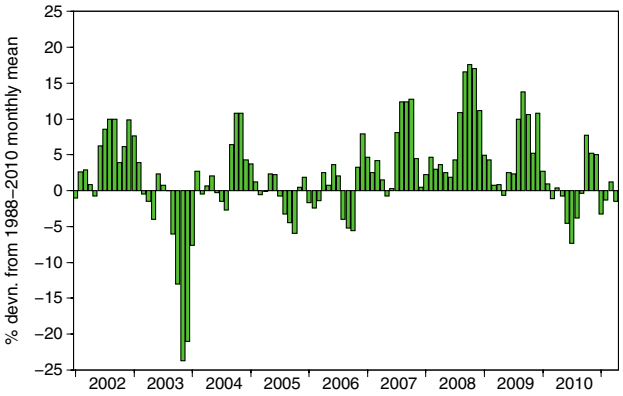
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

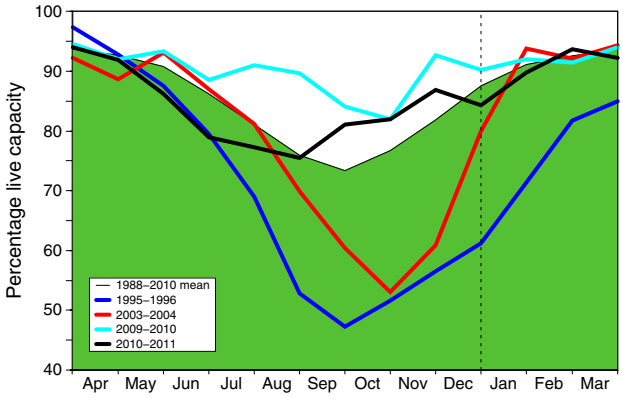
ii. Yew Tree Farm levels are now received quarterly.

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 Feb	Mar	Apr	Apr Anom.	Min Apr	Year* of min	2010 Apr	Diff 11-10
North West	N Command Zone	•	124929	84	97	**91**	-1	77	1993	82	9
	Vyrnwy		55146	95	100	**92**	-3	64	1996	92	0
Northumbrian	Teesdale	•	87936	93	93	**92**	-1	77	2003	96	-4
	Kielder		(199175)	(92)	(91)	**(91)**	-1	(81)	1993	(93)	-2
Severn Trent	Clywedog		44922	91	94	**96**	1	86	1996	92	4
	Derwent Valley	•	39525	92	100	**89**	-6	54	1996	100	-11
Yorkshire	Washburn	•	22035	93	98	**89**	-4	70	1996	95	-6
	Bradford supply	•	41407	92	100	**92**	-2	59	1996	99	-7
Anglian	Grafham		(55490)	(81)	(84)	**(90)**	-1	(77)	1997	(92)	-2
	Rutland		(116580)	(80)	(87)	**(90)**	-1	(74)	1992	(94)	-4
Thames	London	•	202828	91	92	**94**	0	88	1990	92	2
	Farmoor	•	13822	77	76	**95**	0	84	1992	85	10
Southern	Bewl		28170	88	99	**98**	8	58	1989	100	-2
	Ardingly		4685	100	100	**100**	1	88	2006	100	0
Wessex	Clatworthy		5364	86	97	**92**	-5	82	1992	100	-8
	Bristol WW	•	(38666)	(73)	(82)	**(85)**	-9	(71)	1992	(96)	-11
South West	Colliford		28540	84	87	**87**	0	58	1997	99	-12
	Roadford		34500	78	79	**77**	-9	37	1996	92	-15
	Wimbleball		21320	78	93	**91**	-5	78	1996	99	-8
	Stithians		4967	100	100	**98**	4	52	1992	100	-2
Welsh	Celyn and Brenig	•	131155	97	100	**98**	0	72	1996	100	-2
	Brianne		62140	93	98	**94**	-4	90	1993	99	-5
	Big Five	•	69762	95	100	**94**	-2	78	1993	98	-4
	Elan Valley	•	99106	99	100	**94**	-4	89	1993	95	-1
Scotland(E)	Edinburgh/Mid Lothian	•	97639	92	97	**96**	1	71	1998	94	2
	East Lothian	•	10206	100	100	**100**	1	95	1990	100	0
Scotland(W)	Loch Katrine	•	111363	87	93	**91**	-2	74	2010	74	17
	Daer		22412	97	99	**97**	-1	93	2001	94	3
	Loch Thom	•	11840	95	95	**96**	-1	83	2010	83	13
Northern Ireland	Total+	•	56920	94	96	**91**	2	83	2002	99	-8
	Silent Valley	•	20634	91	99	**90**	6	57	2000	100	-10

() 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.
#Pumping from the Thames to Farmoor was reduced in Jan-Feb 2011 due to water quality issues.

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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The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

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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.

04/11