Hydrological Summary
for the United Kingdom

June 2010

General

A notably dry June added significantly to accumulated rainfall deficiencies (in the 6/7 month timeframe) across much of the country. Provisionally, the UK registered its 2nd lowest Jan-June rainfall in a series from 1914 with particularly exceptional deficiencies characterising much of northern England and western Scotland. The recent intensification in drought conditions is confirmed by the estimated June outflows from Great Britain: the lowest in a 50-yr series. Correspondingly, last month saw the 2nd largest June decline in overall reservoir stocks for England & Wales since 1989 and, entering July, stocks in a group of index reservoirs in north west England were only marginally above half full (heralding the introduction of a hosepipe ban affecting 6.5 million consumers). Stocks were also depressed in western Scotland (Loch Katrine especially) and in parts of Wales. Fortunately groundwater levels in most major aquifers (which outcrop extensively in eastern, central and southern England) generally remain within the normal range. As a result, flows in many spring-fed rivers are typical of the early summer. By contrast, flows in many rivers draining impermeable catchments are exceptionally low, causing significant environmental and ecological stress. With extremely dry soils across much of the country (which will absorb most of the summer rainfall) this stress is likely to increase – underlining the need to moderate water usage in the drought-affected regions.

Rainfall

June was a warm month with exceptionally hot interludes triggering increased water demand, high evaporation losses, health stress in vulnerable groups and causing problems for farmers and growers. Persistent high pressure again prevented rain-bearing Atlantic frontal systems from crossing the UK throughout most of the month. There were some showery episodes and a few storms (44mm was recorded at Manston in Kent on the 10/11th) but lengthy periods with little appreciable rainfall were much more typical. At Wallingford only 2.6mm was recorded in the four weeks from the 13th June; the 2nd longest sequence needed to reach this modest threshold since April 2003. June rainfall totals exceeded the monthly average in a few, mostly eastern, pockets (e.g. in Kent), but much of the country reported less than 60% of the 1971-2000 average. Provisionally, it was the driest June since 1995 for the UK, reinforcing rainfall deficiencies which began to build in December 2009. For Scotland, the last seven months have been the driest since 1964 and England & Wales reported its 2nd lowest Jan-Jun rainfall since 1956. Some western catchments registered appreciably below average rainfall in each month and the North West region (of England) received around 40% less than the average for the first half of the year; with the exception of 1929, this is substantially below any other Jan-Jun period in the 96-yr regional rainfall series. Exceptional deficiencies also characterise much of Wales and western Scotland where the Clyde basin recorded its 2nd lowest Dec-Jun rainfall in a series beginning in 1914. Longer term deficiencies are moderated by the extreme wetness of November 2009 across much of the UK.

River flows

Early June saw a continuation of the spring river flow recessions followed by a modest increase in runoff during the second week and, thence, a reassertion of recessions through into July. The June runoff totals provide a convincing general guide to the spatial variations in the intensity of the hydrological drought. Across much of the English Lowlands June flows were below average but well within the normal range – with flows in many Chalk rivers (e.g. the Itchen and Lambourn) tracking close to the average early summer recession. By contrast, flows in many western and northern rivers (which drain impermeable catchments and respond more quickly to rainfall deficiencies) are very depressed. Index rivers registering new minimum June runoff totals were widely distributed – from the Nevis (western Scotland) to the Cynon (South Wales) and previous daily minimum flows (for June) were eclipsed in a number of major rivers e.g. the Ness, Clyde, Tweed and Lune. Correspondingly, environmental drought stress has become increasingly evident, e.g. loss of habitat as the river network contracts, decreasing dilution available for effluents, and low oxygen levels (high water temperatures being an exacerbating factor) necessitating fish rescues. The deteriorating water resources outlook reflects the exceptional meagre runoff since the early winter. In western Scotland, some index rivers (e.g. the Nevis and Luss) have recorded less than 50% of average runoff since last November (a remarkable deficiency for western Scotland) and new minimum Jan-June runoff accumulations have been reported for a number of rivers in north-west England and north Wales. With soil moisture deficits close to early July maxima in many areas (see page 3), very depressed late-summer and autumn flows are in prospect (given normal summer rainfall patterns).

Groundwater

The generally hot and dry June weather produced notably large increases in soil moisture deficits across much of the country. Month-end smds were the highest on record (in a 50-yr series) for Great Britain as a whole, and exceeded previous maxima in much of northern England. Correspondingly, aquifer recharge was minimal during June and 2010 groundwater level recessions continued. The lack of rainfall since the early winter is clearly reflected in some responsive north-western index boreholes, e.g. Newbridge, where early summer levels only marginally exceeded the June minimum. Well below average levels also characterise most limestone wells (e.g. Ampney Crucis and Alstonfield), and many minor aquifers. However, even in a normal year, summer rainfall has little impact on levels in the major aquifers and current levels throughout most of the Chalk and Permo-Triassic sandstones outcrops (the Magnesian Limestone also) remain well within the normal summer range. The particular value of groundwater during spring-summer rainfall deficiencies is being well demonstrated but the exceptionally dry soils may be expected to delay the seasonal onset of recharge in the autumn and fuel concern about the groundwater resources prospects for 2011 in the event of a dry winter.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

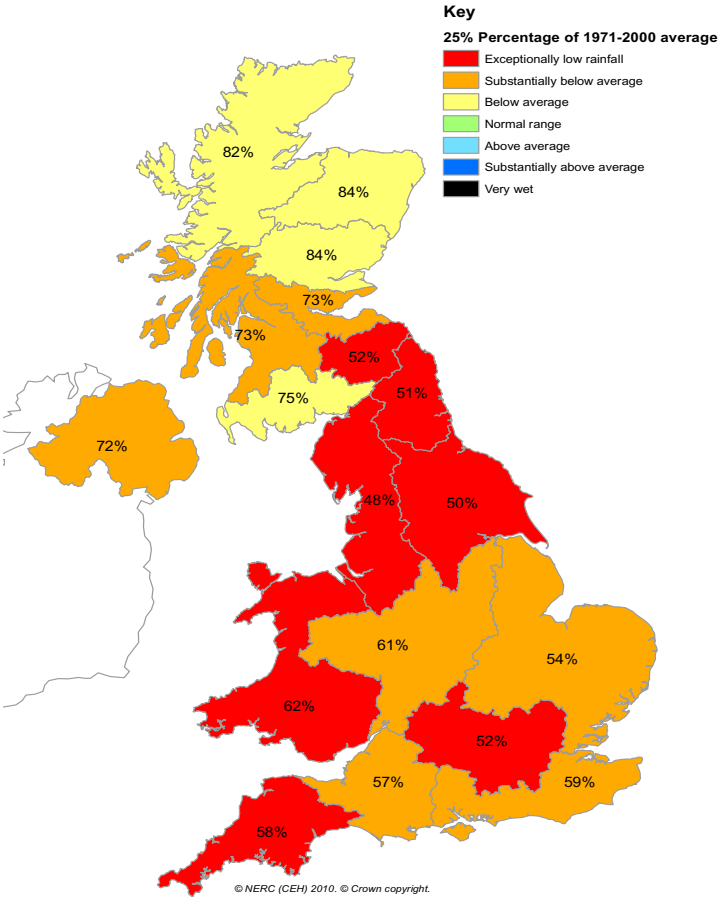
Area	Rainfall	Jun 2010	Apr10 - Jun10	RP	Jan10 - Jun10	RP	Nov09 - Jun10	RP	Jul09 - Jun10	RP
England & Wales	**mm**	**39**	**101**		**310**		**603**		**920**	
	%	**60**	**56**	**35-50**	**75**	**10-20**	**100**	**2-5**	**103**	**2-5**
North West	mm	**40**	102		311		715		1192	
	%	**51**	48	60-90	60	>100	92	2-5	101	2-5
Northumbrian	mm	**38**	91		335		631		981	
	%	**62**	51	30-45	86	2-5	113	2-5	118	5-10
Severn Trent	mm	**45**	104		263		468		731	
	%	**73**	61	10-20	73	10-20	92	2-5	96	2-5
Yorkshire	mm	**45**	88		299		560		851	
	%	**72**	50	30-50	78	5-10	102	2-5	104	2-5
Anglian	mm	**37**	78		240		410		599	
	%	**67**	54	10-20	85	2-5	104	2-5	99	2-5
Thames	mm	**26**	84		275		515		717	
	%	**46**	52	20-30	83	2-5	110	2-5	102	2-5
Southern	mm	**41**	93		344		675		883	
	%	**73**	59	10-20	98	2-5	129	10-20	113	2-5
Wessex	mm	**31**	98		303		593		885	
	%	**52**	57	15-25	75	5-10	101	2-5	102	2-5
South West	mm	**37**	123		406		783		1232	
	%	**51**	58	15-25	73	5-15	93	2-5	102	2-5
Welsh	mm	**42**	144		402		854		1348	
	%	**53**	62	20-30	68	40-60	95	2-5	102	2-5
Scotland	**mm**	**42**	**181**		**451**		**816**		**1468**	
	%	**53**	**78**	**5-15**	**70**	**15-25**	**84**	**2-5**	**102**	**2-5**
Highland	mm	**45**	215		497		846		1579	
	%	**50**	82	5-10	64	10-20	72	5-15	92	2-5
North East	mm	**41**	162		426		706		1224	
	%	**62**	84	2-5	98	2-5	113	2-5	129	20-35
Tay	mm	**48**	177		422		782		1359	
	%	**69**	84	2-5	71	10-20	90	2-5	107	2-5
Forth	mm	**38**	145		388		707		1219	
	%	**55**	73	5-10	75	5-10	94	2-5	108	2-5
Tweed	mm	**26**	99		383		719		1174	
	%	**40**	52	40-60	87	2-5	112	5-10	123	10-20
Solway	mm	**44**	176		448		914		1625	
	%	**56**	75	5-10	72	10-20	98	2-5	115	10-20
Clyde	mm	**41**	188		466		917		1701	
	%	**46**	73	10-20	61	30-40	80	5-10	98	2-5
Northern Ireland	**mm**	**47**	**151**		**400**		**697**		**1152**	
	%	**65**	**72**	**5-15**	**79**	**5-10**	**95**	**2-5**	**104**	**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 derived following the method described in: Tabony, R. C. 1977, *The variability of long duration rainfall over Great Britain*. Met Office Scientific Paper no. 37. The estimates reflect climatic variability since 1913 and assume a stable climate. 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 January 2010 are provisional.

Rainfall . . . Rainfall . . .

April - June 2010



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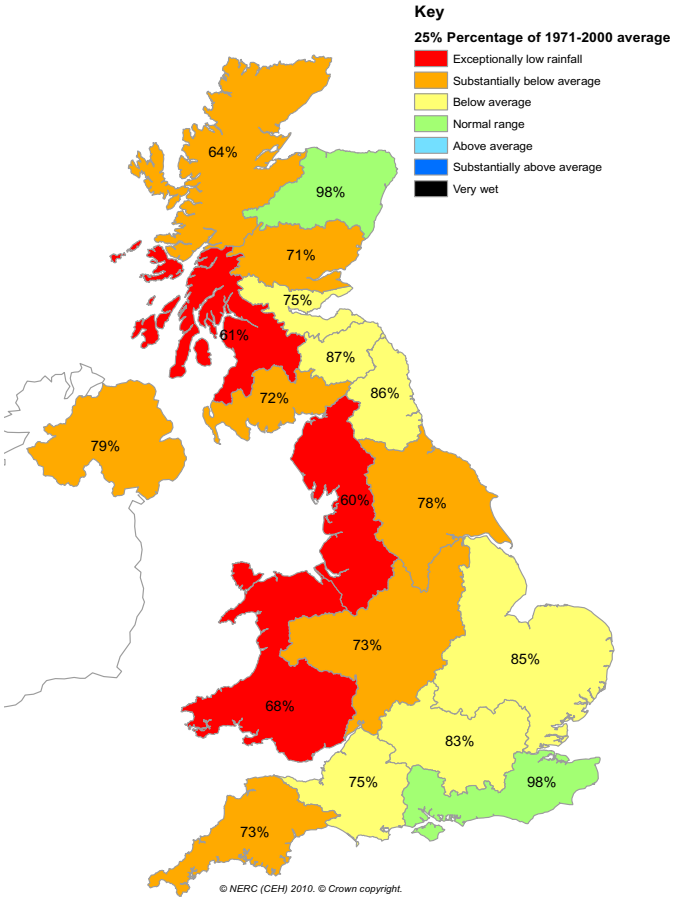
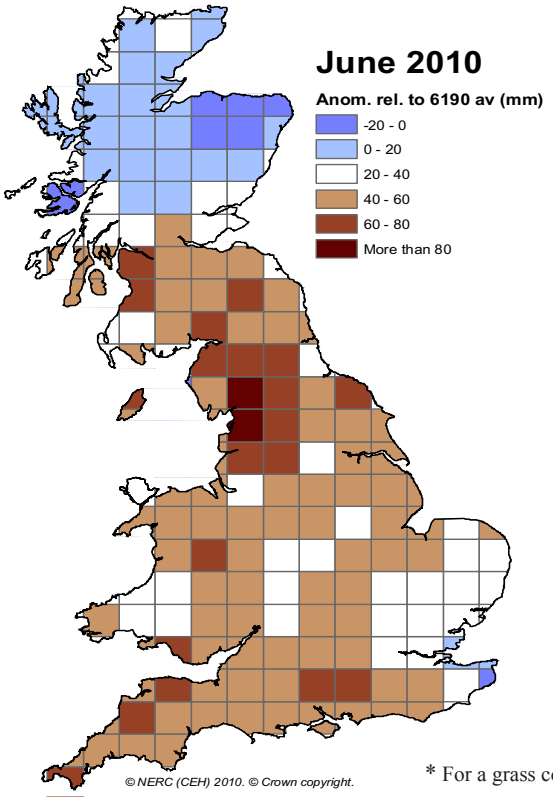


MORECS Soil Moisture Deficits *



* For a grass cover

Met Office Weather forecast

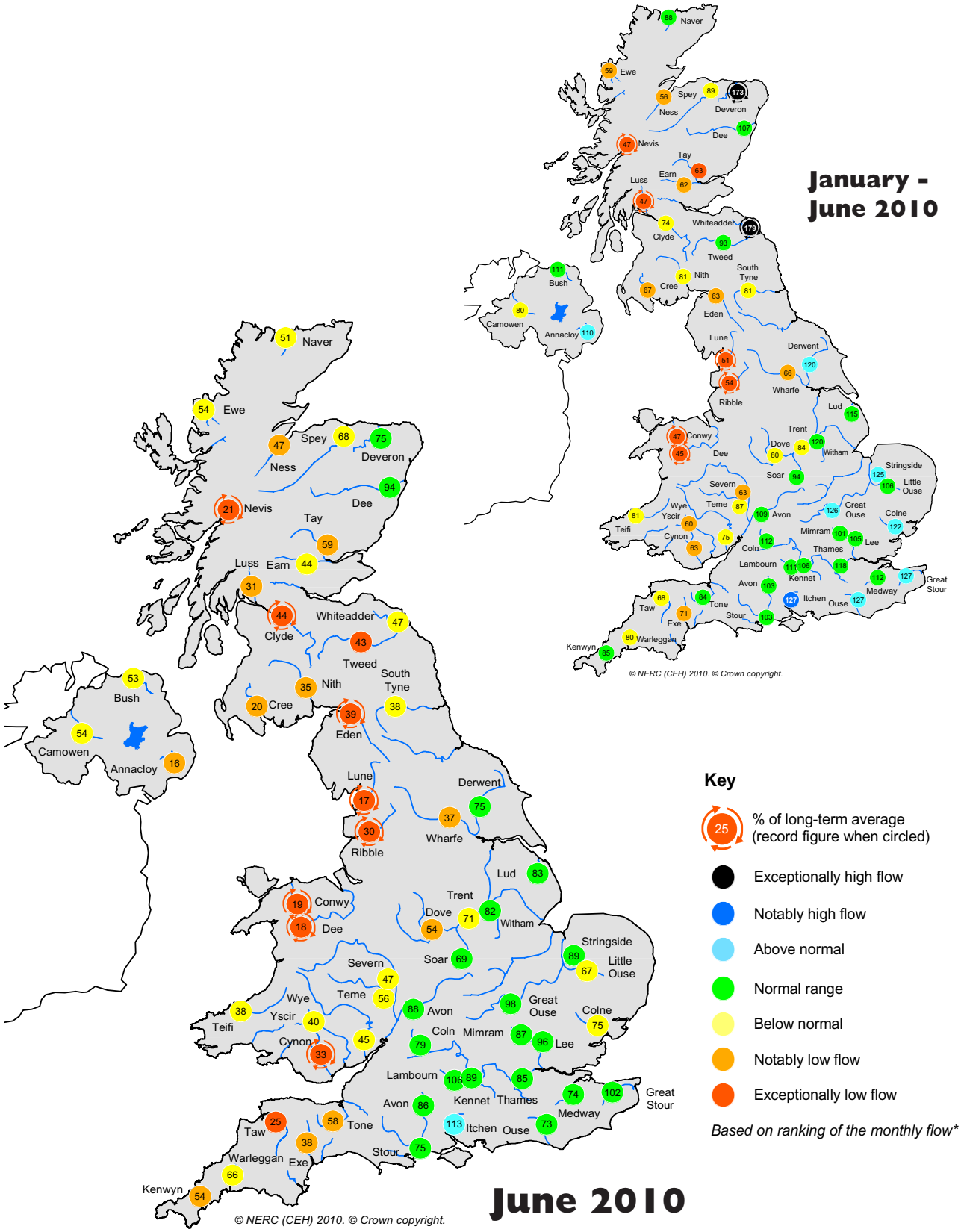
Updated: 12:07 on Tue 13 Jul 2010

UK Outlook for Sun 18 Jul to Tues 27 Jul 2010:
Turning wetter in northern and western parts of the UK on Sunday, with rain gradually spreading east to most remaining parts. However, southeastern England should stay mostly dry and bright. Early in the week, a change to sunshine and scattered showers is expected for many, especially northwestern parts of the UK. It may become drier and brighter around midweek, particularly in southeast England. For the rest of the period, northwestern parts of the UK will retain the greatest chance of seeing further rain, with southeastern areas staying drier, brighter and warmer. Winds may become quite strong across northwestern parts of the UK, and here, temperatures will stay near normal. Further south and east, temperatures should be slightly above normal, feeling warm or very warm.

UK Outlook for Weds 28 Jul to Weds 11 Aug 2010:
The warm theme is expected to continue in southern parts of the UK, with much of England and Wales seeing temperatures above average. Scotland, Northern Ireland and, at times, northern England are likely to experience temperatures closer to normal. Sunshine amounts seem likely to be around average for the time of year and rainfall totals should also be generally near normal, though Scotland may turn out to be slightly wetter at times.

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

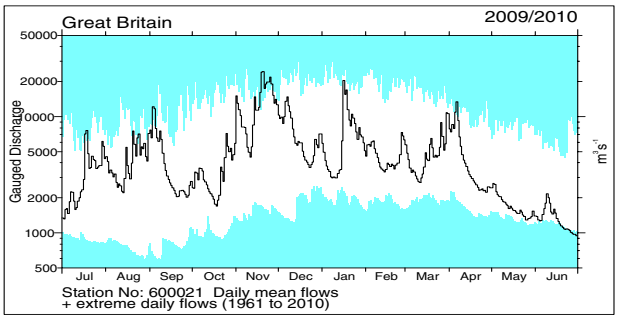
River flow . . . River flow . . .

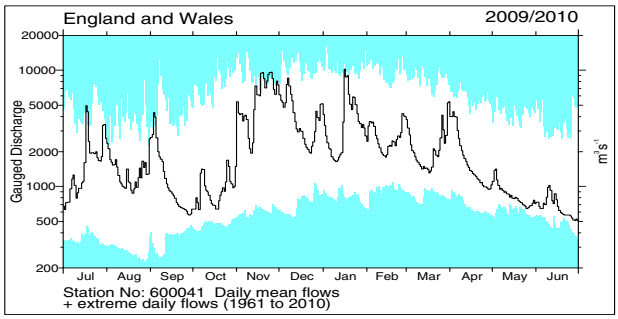


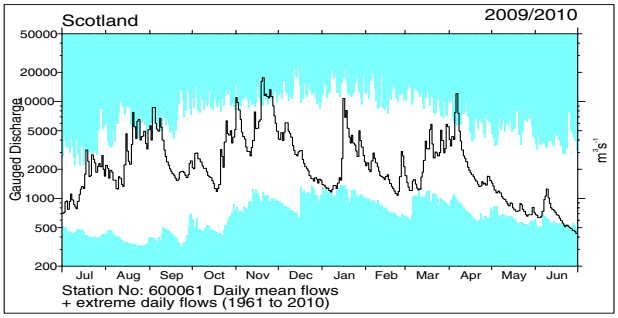
River flows

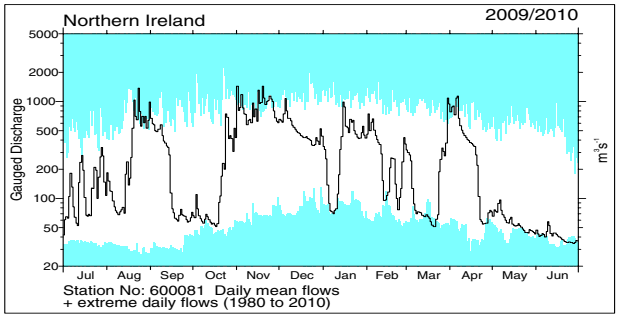
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

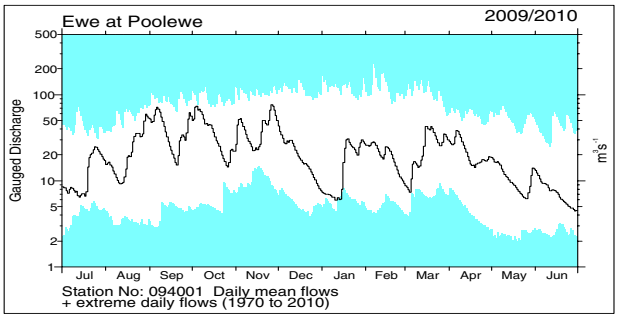
River flow . . . River flow . . .

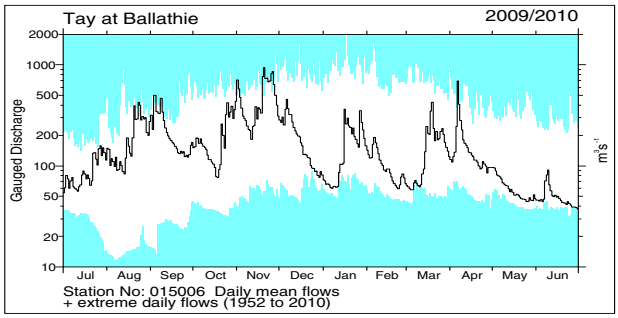


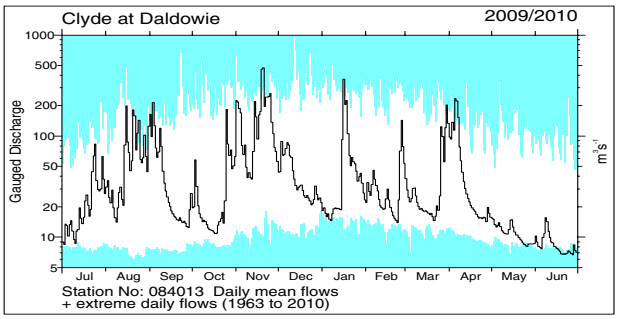


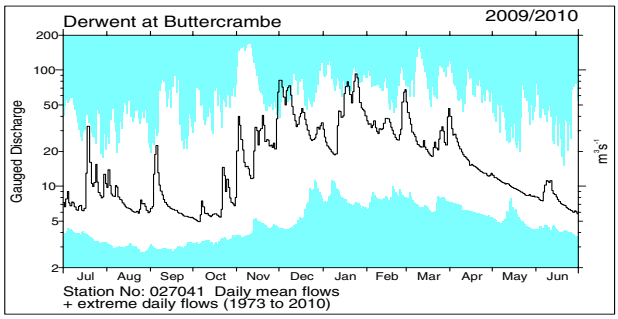


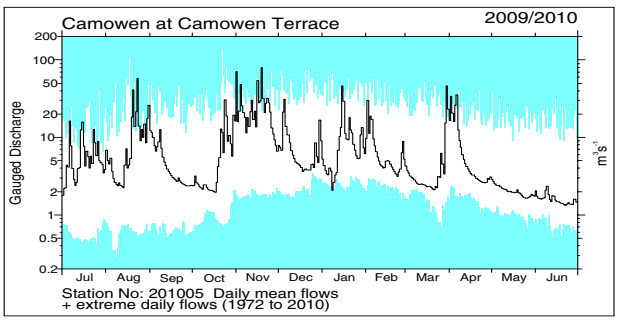


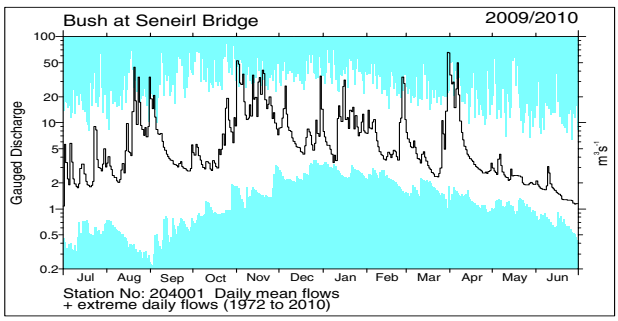








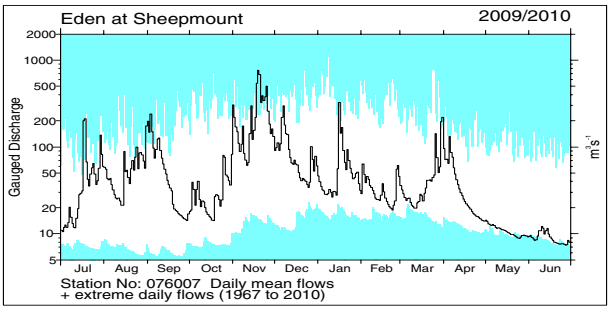


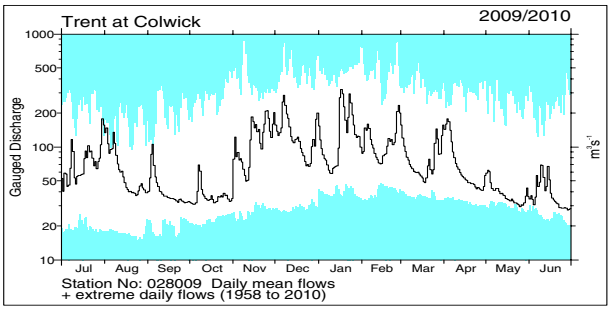


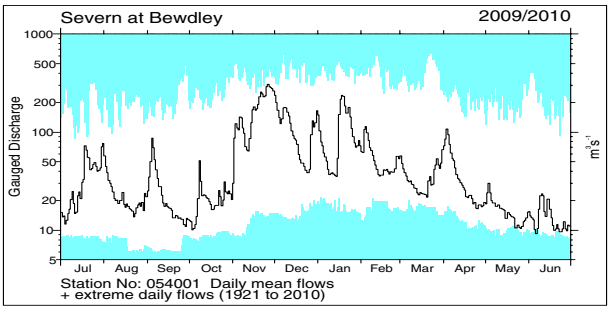
River flow hydrographs

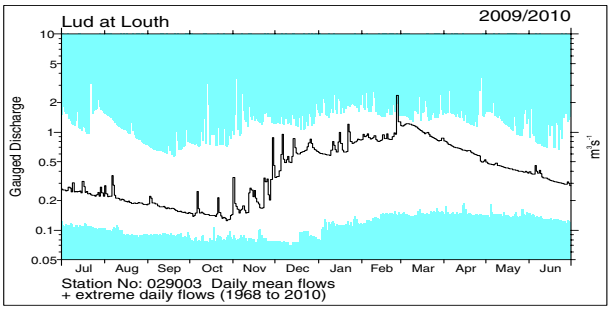
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to July 2009 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

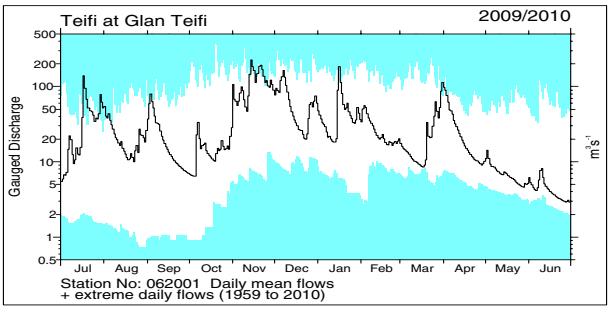
River flow . . . River flow . . .

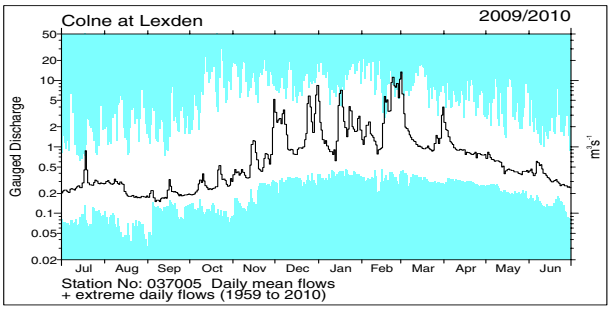


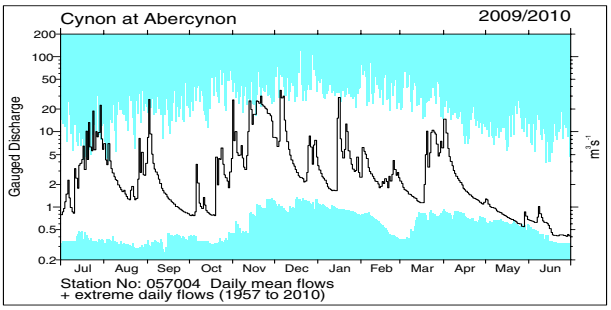


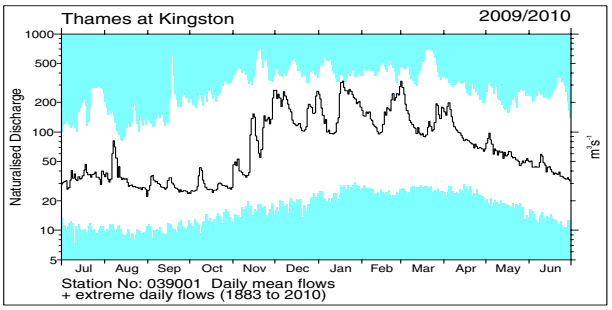


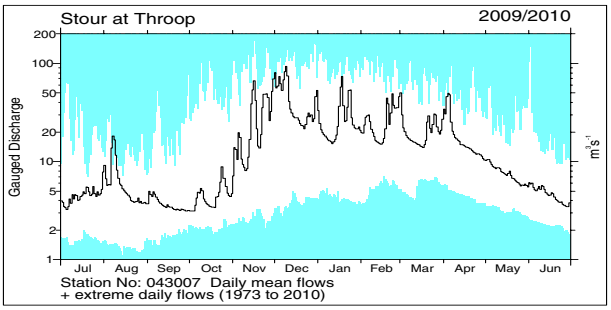


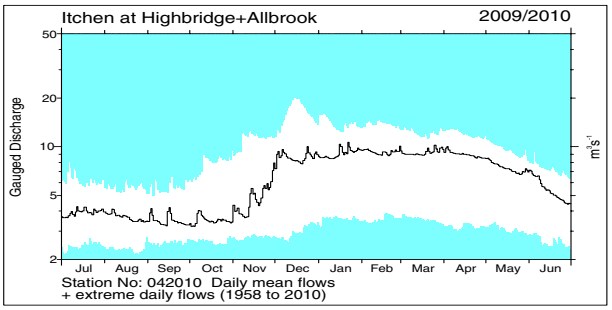












Notable runoff accumulations (a) January - June 2010

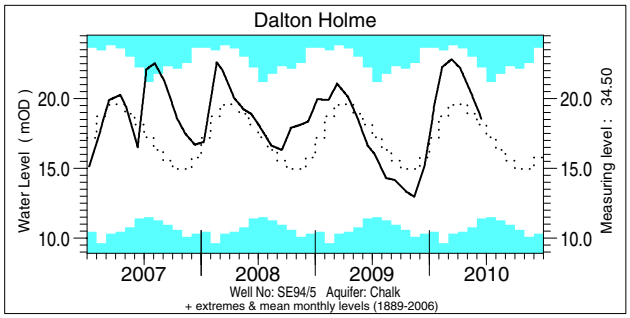
	River	%lta	Rank
a)	Ness	56	2/38
	Deveron	173	50/50
	Tay	63	2/58
	Earn	62	4/63
	Forth	49	1/29
	Tyne (Spilmersford)	180	46/46
	Whiteadder	179	41/41
	Wharfe	66	3/55

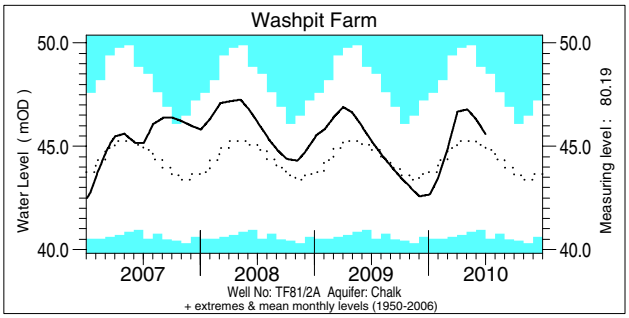
	River	%lta	Rank
a)	Yscir	60	2/38
	Tawe	63	3/50
	Tywi	67	4/52
	Conwy	47	1/43
	Dee (New Inn)	45	1/41
	Ribble	54	1/50
	Lune	51	1/50
	Eden	63	3/43

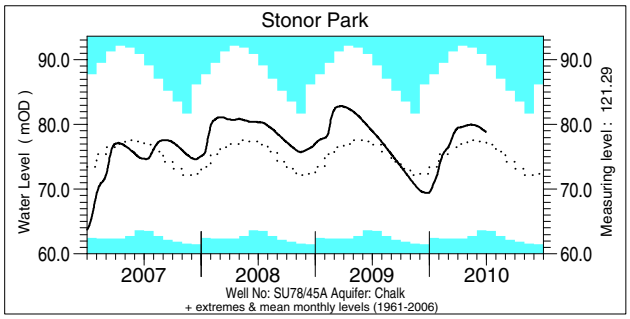
	River	%lta	Rank
a)	Cree	67	4/47
	Luss	47	1/32
	Nevis	47	1/28
	Ewe	59	5/40
	Mourne	68	2/28
	Faughan	71	3/34
	L Bann	79	5/30

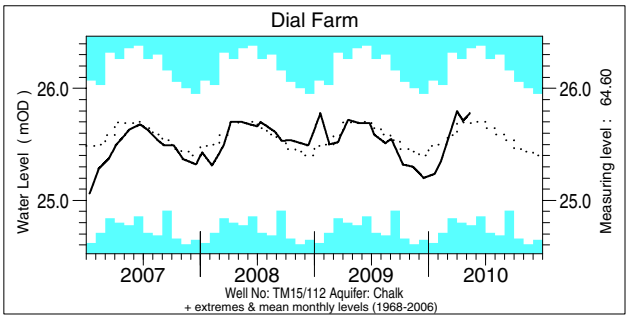
lta = long term average
Rank 1 = lowest on record

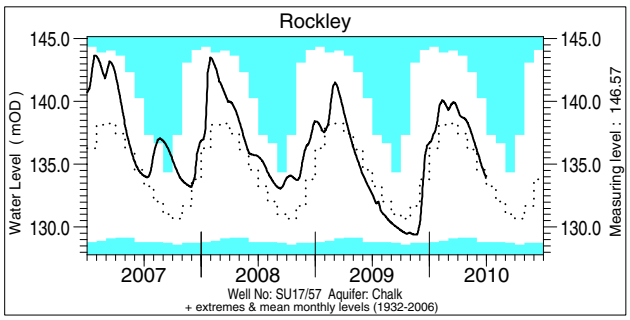
Groundwater . . . Groundwater

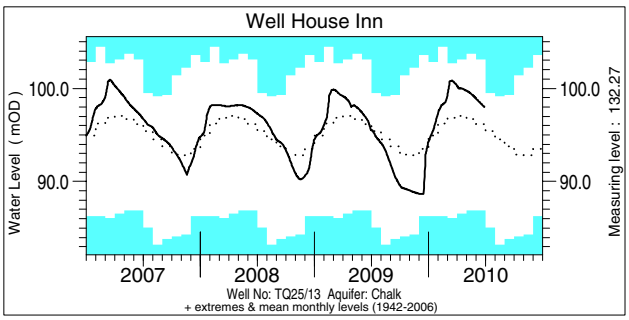


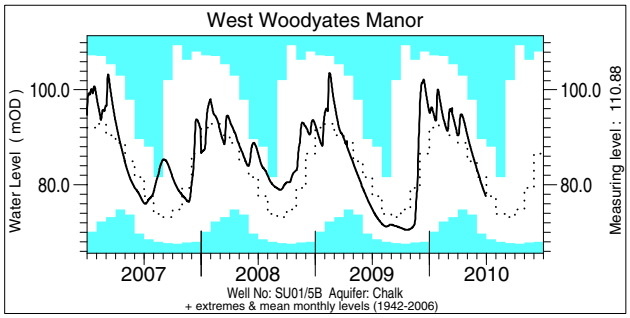


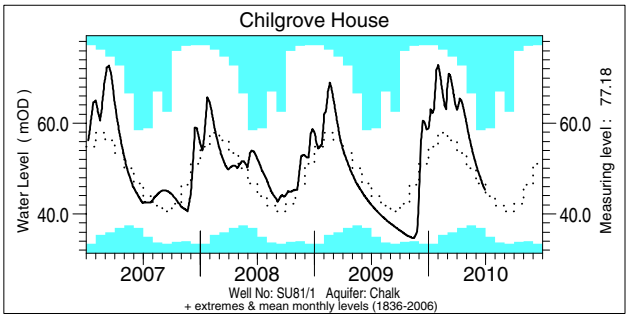


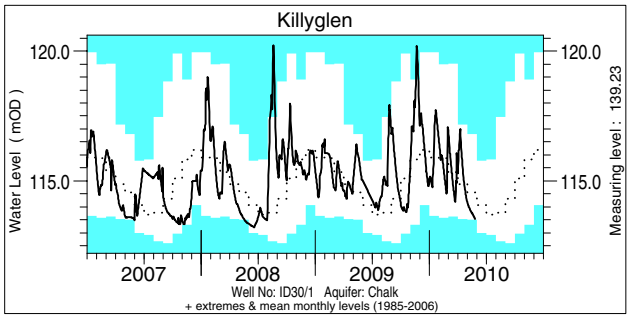


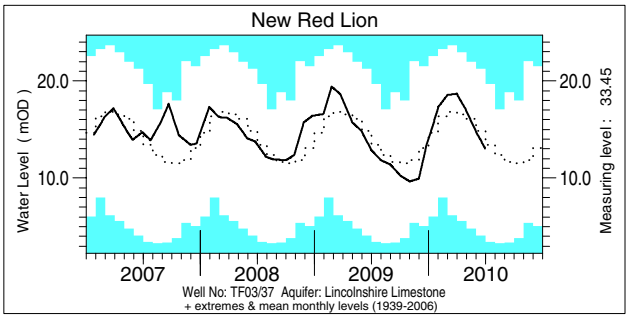






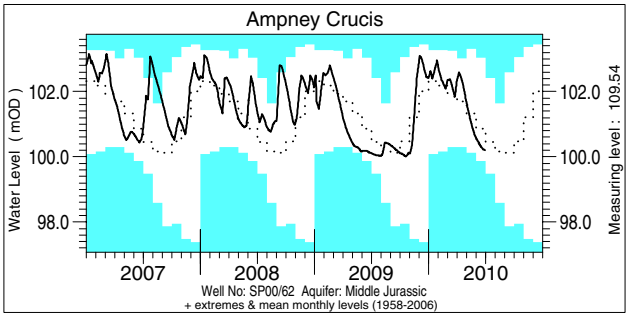


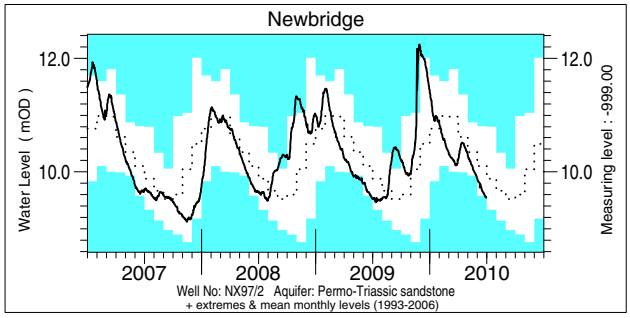


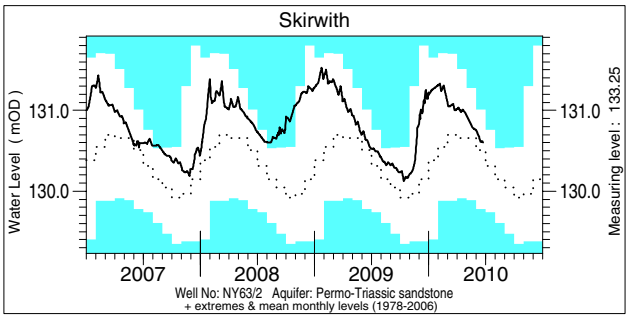


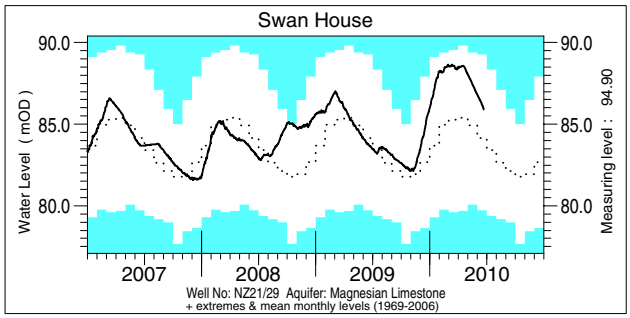
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

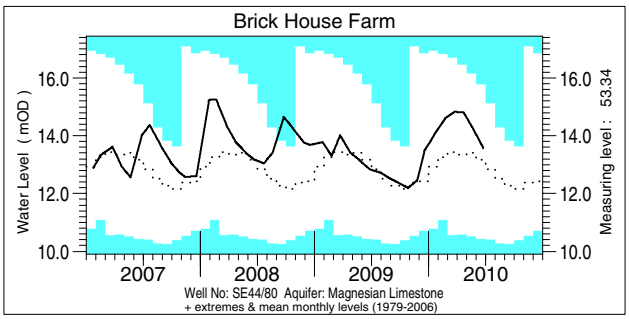
Groundwater . . . Groundwater

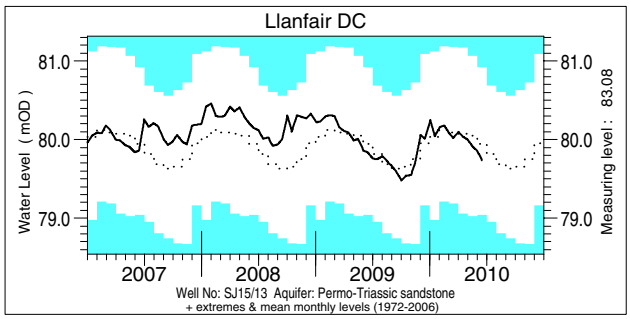


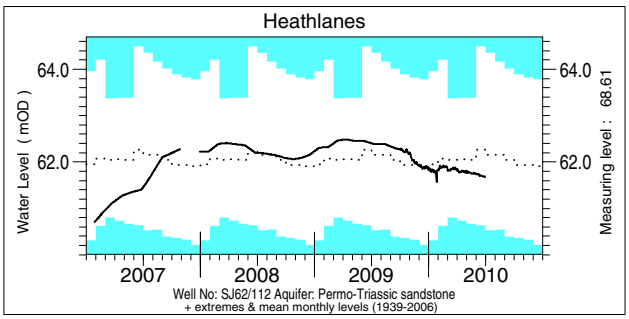


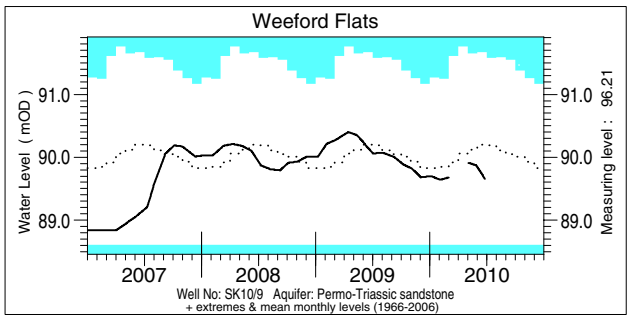


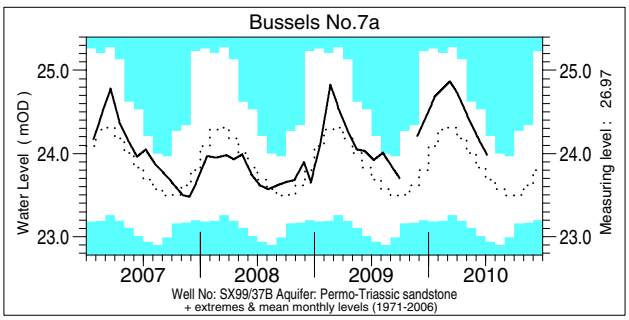


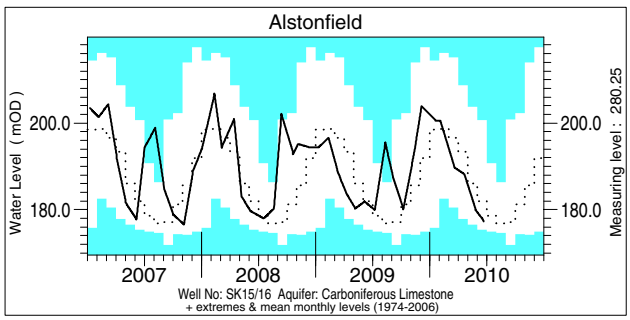












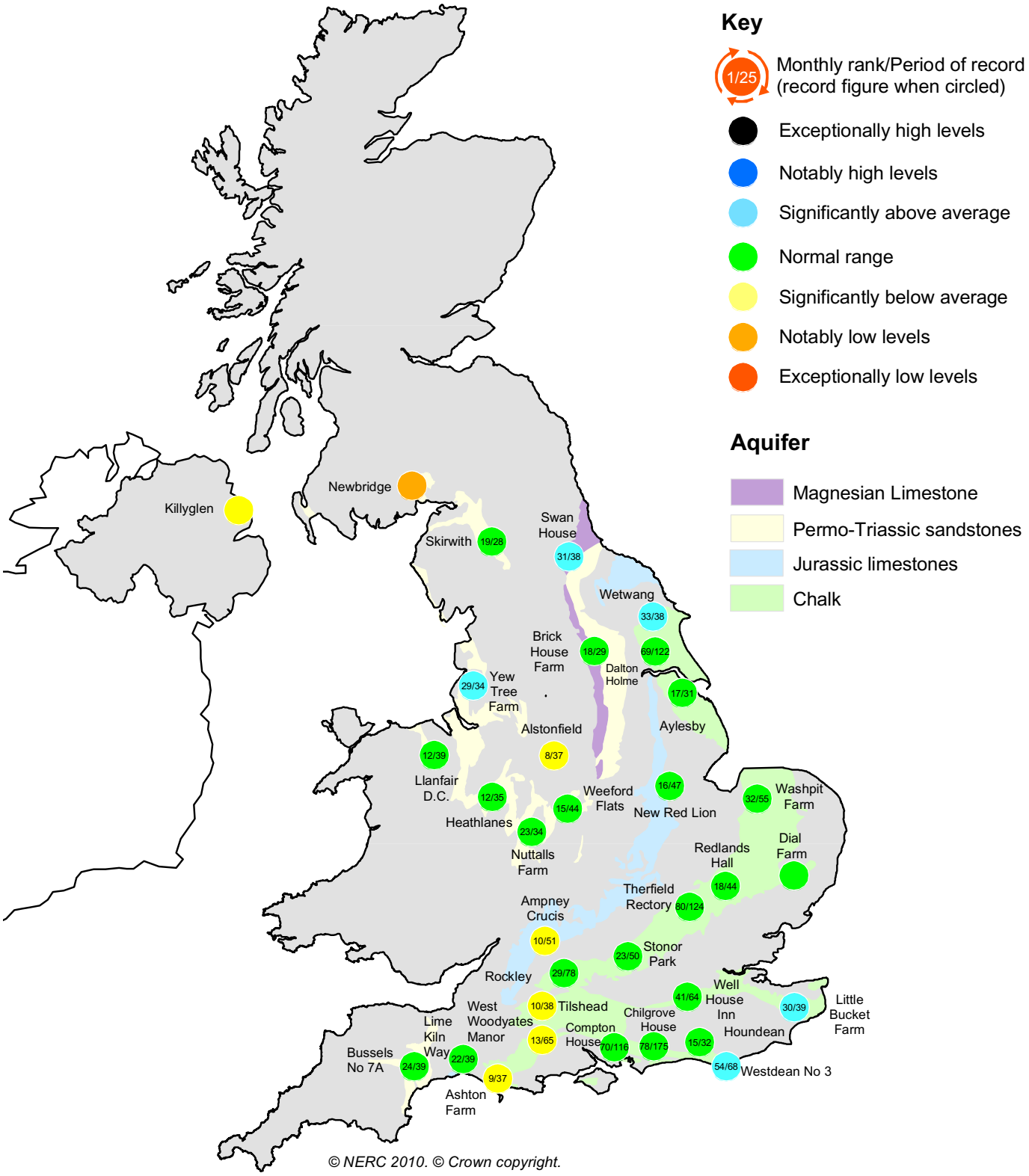
Groundwater levels June / July 2010

Borehole	Level	Date	Jun av.
Dalton Holme	18.54	15/06	18.11
Washpit Farm	45.58	01/07	45.21
Stonor Park	78.83	30/06	77.75
Dial Farm	25.78	12/05	25.69
Rockley	133.92	30/06	134.57
Well House Inn	97.99	28/06	96.46
West Woodyates	77.57	30/06	80.97

Borehole	Level	Date	Jun. av.
Chilgrove House	45.24	30/06	46.02
Killyglen (NI)	113.52	26/05	114.01
New Red Lion	13.02	30/06	14.45
Ampney Crucis	100.20	30/06	100.86
Newbridge	9.54	30/06	10.00
Skirwith	130.60	23/06	130.51
Swan House	85.91	22/06	84.11

Borehole	Level	Date	Jun. av.
Brick House Farm	13.57	24/06	13.12
Llanfair DC	79.74	15/06	79.87
Heathlanes	61.69	30/06	62.20
Weeford Flats	89.65	25/06	89.95
Bussels No.7a	23.98	06/07	23.86
Alstonfield	177.29	22/06	181.66

Levels in metres above Ordnance Datum



Groundwater levels - June 2010

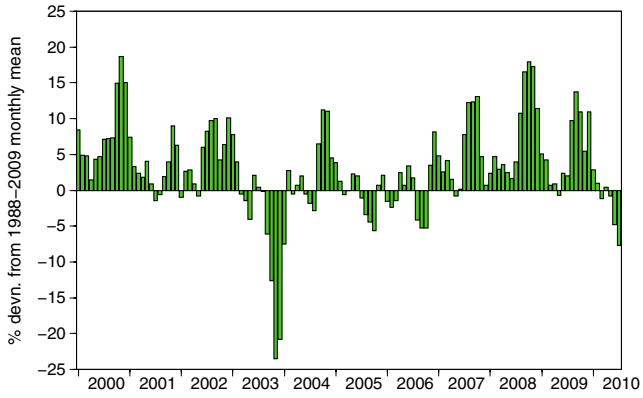
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

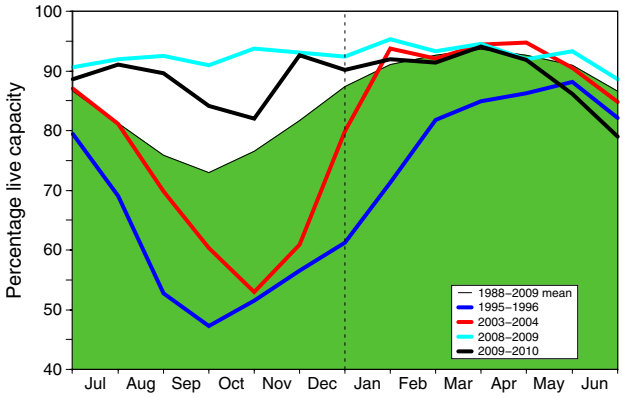
ii. Yew Tree Farm levels are now received quarterly.

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 May	Jun	Jul	Jul Anom.	Min Jul	Year* of min	2009 Jul	Diff 10-09
North West	N Command Zone	•	124929	82	66	**52**	-21	**52**	**2010**	78	-26
	Vyrnwy		55146	90	79	**68**	-15	65	1990	74	-6
Northumbrian	Teesdale	•	87936	85	74	**63**	-16	58	1989	84	-21
	Kielder		(199175)	(88)	(87)	**(84)**	-6	(71)	1989	(91)	-7
Severn Trent	Clywedog		44922	96	95	**88**	-6	72	1989	100	-12
	Derwent Valley	•	39525	94	80	**68**	-13	53	1996	79	-11
Yorkshire	Washburn	•	22035	87	80	**72**	-9	63	1995	84	-12
	Bradford supply	•	41407	89	77	**65**	-14	54	1995	78	-13
Anglian	Grafham		(55490)	(93)	(91)	**(92)**	-1	(70)	1997	(92)	0
	Rutland		(116580)	(92)	(90)	**(87)**	-1	(75)	1997	(85)	2
Thames	London	•	202828	93	96	**94**	3	85	1990	95	-1
	Farmoor	•	13822	97	92	**95**	-2	94	1995	95	0
Southern	Bewl		28170	100	94	**81**	-1	52	1990	76	5
	Ardingly		4685	100	100	**93**	-2	82	2005	86	7
Wessex	Clatworthy		5364	99	87	**70**	-13	61	1995	75	-5
	Bristol WW	•	(38666)	(95)	(86)	**(77)**	-5	(64)	1990	(77)	0
South West	Colliford		28540	99	94	**88**	6	51	1997	97	-9
	Roadford		34500	92	88	**80**	-2	49	1996	89	-9
	Wimbleball		21320	98	90	**79**	-7	63	1992	89	-10
	Stithians		4967	95	81	**79**	0	53	1990	85	-6
Welsh	Celyn and Brenig	•	131155	99	93	**83**	-11	77	1996	97	-14
	Brianne		62140	97	89	**82**	-11	76	1995	96	-14
	Big Five	•	69762	93	83	**70**	-14	61	1989	85	-15
	Elan Valley	•	99106	94	86	**77**	-12	75	1989	95	-18
Scotland(E)	Edinburgh/Mid Lothian	•	97639	97	95	**81**	-5	54	1998	93	-12
	East Lothian	•	10206	100	99	**94**	0	81	1992	97	-3
Scotland(W)	Loch Katrine	•	111363	80	70	**55**	-26	**55**	**2010**	84	-29
	Daer		22412	97	85	**74**	-10	62	1994	93	-19
	Loch Thom	•	11840	83	98	**82**	-3	69	2000	95	-13
Northern Ireland	Total+	•	56920	92	82	**73**	-9	61	2008	86	-13
	Silent Valley	•	20634	91	82	**74**	-3	54	1995	85	-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 1988-2009 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.
The London total has been revised to 202828 Ml as of April 2010.

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 (together with revised 1961-90 averages) were made available by the Met Office in 2004; these have been adopted by the NHMP. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.
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.

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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 Water Watch

07/10