Hydrological Summary

for the United Kingdom

March 2009

General

March was a mild and relatively dry month, parts of Scotland apart, with some notable rainless interludes. These contributed to significant two-month rainfall deficiencies across much of the country at an important time for the water resources outlook; increasing evaporation demands normally curtail the aquifer recharge season during the late spring. Overall, reservoir stocks for England & Wales were above average for the 23rd successive month – but only marginally so and stocks were considerably below the early April average in a few major impoundments (e.g. in north-west England). In Scotland and Northern Ireland, stocks in index reservoirs are well within the normal seasonal range. River flow recessions extended through much of March and runoff rates were depressed in many responsive rivers by early April. With limited rainfall in most outcrop areas and soil moisture deficits beginning to build, aquifer recharge to most major aquifers was modest and seasonal groundwater level recessions have become established in many areas. Nonetheless, March groundwater levels were well within the normal range across most of the country. The last ten weeks has seen an appreciable deterioration in the water resources outlook but overall surface and groundwater resources remain typical of the late spring (in part, this is a reflection of the unusually high runoff and recharge during the autumn of 2008).

Rainfall

Overall, March was warmer and sunnier than average with high pressure dominant throughout much of the month across the majority of the country. The first week was very unsettled with significant snowfall in Scotland on the 3rd and 5th (when, more exceptionally, some locally heavy snowstorms – with accumulations up to 15cm – were recorded in south-west England). Generally however, notable storm rainfall totals were rare in March and the most hydrologically significant features were the extended dry episodes in mid-month. Large areas reported accumulated rainfall totals of < 2mm over periods of 18 days or more; some central southern areas (e.g. south Oxfordshire) reported less than a third of their average rainfall over the eight weeks to early April. This dry spell is reflected in the March rainfall totals. Whilst much of northern Scotland registered well above average rainfall, March totals declined markedly to the south with substantial parts of Wales and southern England reporting less than 50% of average. More significantly, 2-month deficiencies are exceptional in a number of regions. Over the February-March period, provisional data indicate that Northern Ireland equalled its lowest rainfall total in the last 56 years and the Welsh Region its 2nd lowest in the last 53 years. Much of northern England was also notably dry in this timeframe. Substantial rainfall deficiencies are more extensive (encompassing much of north-east England and eastern Scotland) over the November-March period. Fortunately from a water resources perspective, regional rainfall accumulations over the last 12-months (and for longer periods) are generally above average.

River flows

In most index catchments the sustained February river flow recessions were arrested during the first week of March and a few notable spates were registered (e.g. on the Mole and Medway). Flows then declined steeply through the middle of the month and, entering April, flows in responsive rivers were seasonally depressed over wide areas. In parts of western and northern Scotland however, above average rainfall and snowmelt contributions maintained very healthy runoff rates – flows in the River Ewe remained above average throughout March. Across much of southern Britain, geological control over runoff rates was particularly evident during March. Flows in many impermeable catchments (e.g. the Soar, Lymington and Warleggan) were substantially below the early spring average by month-end. In contrast, flows in many groundwater-fed streams and rivers (e.g. the Mimram and Lambourn) remained appreciably above average – a consequence of the delayed benefit of exceptional recharge over the latter half of 2008. Relative to the long term average, March runoff totals displayed marked spatial variability. Categorising broadly: above average runoff characterised northern Scotland, whilst runoff in the English Lowlands was typical of the early spring but, elsewhere, runoff totals were well below average notably so in a few western catchments. The Teifi reported its 3rd lowest March runoff in 47 years, the Annacloy its 2nd lowest in a 30-year series. Two-month accumulations are also generally below average but medium and longer term accumulations remain healthy.

Groundwater

A wet start to March allowed some useful infiltration but, thereafter, soils began to dry out once more and, by month-end, soil moisture deficits exceeded the late-March average across the outcrop areas of most major aquifers (much of Norfolk was an exception). With March rainfall falling below 70% of average in most outcrop areas, aquifer replenishment was typically less than half the average. The corresponding decline in groundwater levels in the South Downs almost certainly marks the end of the at-risk period for localities vulnerable to groundwater flooding. More generally, the dryness of the early spring is reflected in the steep recessions which characterise a number of index wells in the limestone (e.g. Ampney Crucis and Alstonfield) and Permo-Triassic sandstones (e.g. Newbridge) outcrop areas. Similarly brisk recessions are found in the responsive (mostly western and southern) outcrop areas of the Chalk (see West Woodyates for example). Levels were still rising during March in the slower-responding aquifer units (e.g. at Heathlanes and in the deep Therfield well in the eastern Chalk). The dry start to April may signal the end of the 2008/09 recharge season in many eastern and central aquifer outcrop areas but, fortunately, the seasonal peak groundwater levels registered in the late winters were generally above average — providing at least a partial counterbalance to the early onset of the 2009 recessions. Given normal rainfall patterns, a typical seasonal decline in groundwater levels is in prospect but the magnitude and distribution of late spring rainfall may well influence the steepness of the recessions.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

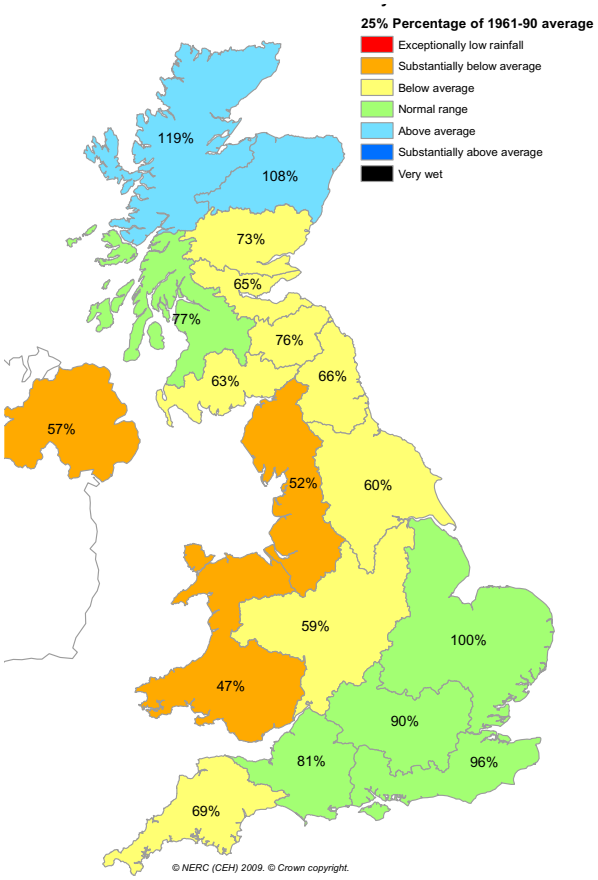
Area	Rainfall	Mar 09	Feb 09- Mar 09	RP	Nov 08- Mar 09	RP	Aug 08- Mar 09	RP	Apr 08- Mar 09	RP
England & Wales	**mm**	**45**	**93**		**336**		**673**		**975**	
	%	**62**	**67**	**2-5**	**81**	**5-10**	**103**	**2-5**	**108**	**2-5**
North West	mm	**66**	91		407		944		1294	
	%	**68**	52	5-15	75	5-10	105	2-5	106	2-5
Northumbrian	mm	**41**	87		288		667		1002	
	%	**57**	66	5-10	75	5-15	108	2-5	116	5-10
Severn Trent	mm	**34**	69		271		554		816	
	%	**55**	59	5-10	80	5-10	103	2-5	106	2-5
Yorkshire	mm	34	76		273		582		885	
	%	**50**	60	5-10	74	5-15	99	2-5	106	2-5
Anglian	mm	**33**	85		241		447		659	
	%	**71**	100	<2	97	2-5	110	2-5	109	2-5
Thames	mm	**32**	92		289		493		767	
	%	**57**	90	2-5	94	2-5	101	2-5	109	2-5
Southern	mm	**42**	113		359		574		829	
	%	**67**	96	2-5	98	2-5	100	<2	106	2-5
Wessex	mm	**45**	110		353		634		943	
	%	**63**	81	2-5	87	2-5	101	2-5	110	2-5
South West	mm	**65**	139		472		863		1269	
	%	**65**	69	2-5	77	5-10	95	2-5	106	2-5
Welsh	mm	**66**	100		476		1038		1426	
	%	**61**	47	10-20	73	10-20	102	2-5	106	2-5
Scotland	**mm**	**148**	**224**		**675**		**1181**		**1519**	
	%	**116**	**96**	**2-5**	**96**	**2-5**	**105**	**2-5**	**103**	**2-5**
Highland	mm	**226**	338		940		1485		1827	
	%	**143**	119	2-5	110	2-5	110	5-10	105	2-5
North East	mm	**82**	164		421		744		1049	
	%	**100**	108	2-5	92	2-5	100	<2	102	2-5
Tay	mm	**106**	154		509		944		1248	
	%	**93**	73	2-5	82	2-5	97	2-5	97	2-5
Forth	mm	**84**	117		378		835		1143	
	%	**85**	65	5-10	72	10-20	97	2-5	100	<2
Tweed	mm	**63**	115		358		802		1162	
	%	**77**	76	2-5	80	5-10	110	2-5	116	10-20
Solway	mm	**107**	140		575		1205		1560	
	%	**90**	63	5-10	86	2-5	110	5-10	109	5-10
Clyde	mm	**161**	212		730		1359		1745	
	%	**106**	77	2-5	88	2-5	100	<2	100	<2
Northern Ireland	**mm**	**64**	**98**		**391**		**861**		**1125**	
	%	**70**	**57**	**5-15**	**77**	**10-20**	**106**	**2-5**	**102**	**2-5**

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

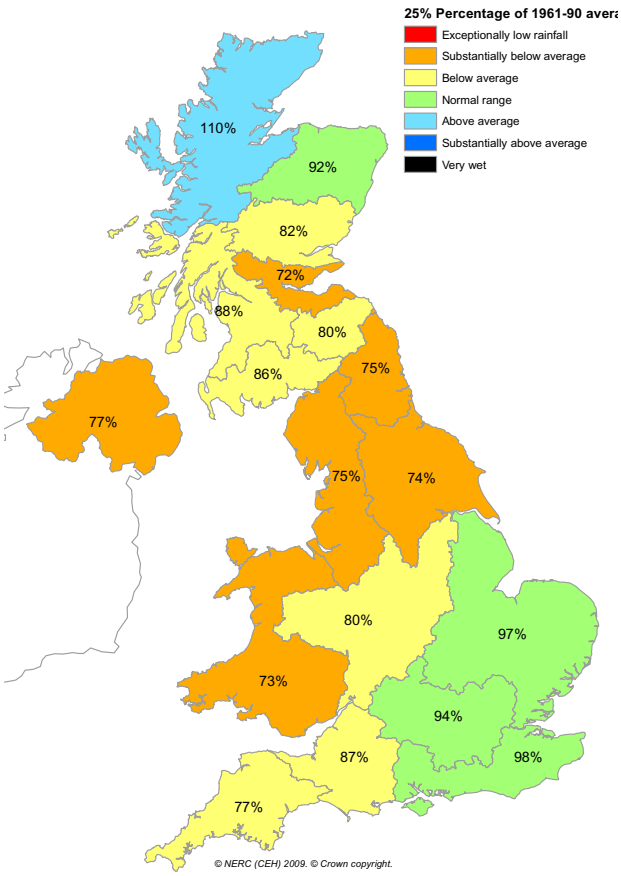
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and derived following 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 July 2008 are provisional.

Rainfall . . . Rainfall . . .

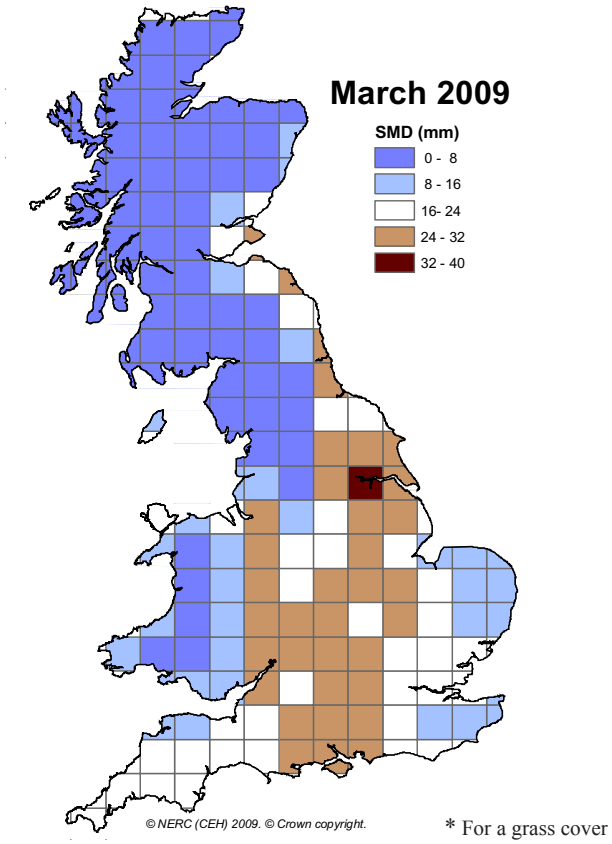
February - March 2009



November 2008 - March 2009



MORECS Soil Moisture Deficits *



* For a grass cover

Met Office Spring 2009 forecast

Forecast for the Spring 2009:
issued 25 March 2009

Temperature
For the UK and western Europe mean temperatures for the rest of spring are likely to be either near or below average. In contrast, mean temperatures are likely to be near average or above average over much of eastern Europe.

Rainfall
For the UK and much of northern Europe precipitation is likely to be average or below average. In contrast, average or above-average rainfall is likely over southern Europe and the central Mediterranean.

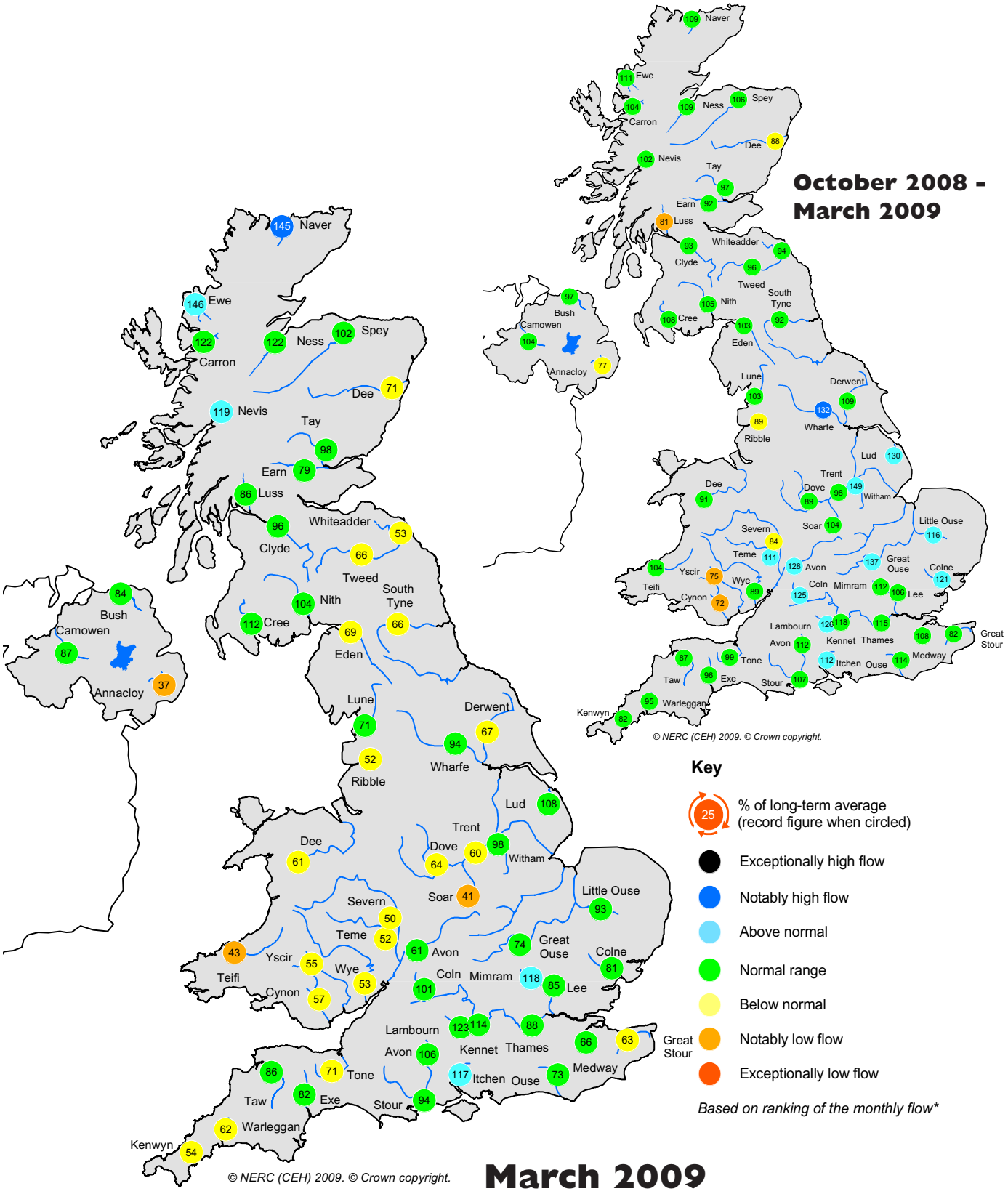
Forecast for the Summer 2009:
issued 31 March 2009

Temperature
For the UK and much of western Europe temperatures are likely to be near average.

Rainfall
At this stage forecast signals are too weak to provide an outlook for summer rainfall.

Updates and reviews of the forecast
The forecasts will be updated by 11 a.m. on 23 April 2009 (spring) and by 11 a.m. on 30 April 2009 (summer).
For further details please visit:
http://www.metoffice.gov.uk/science/creating/monthsahead/seasonal/2009/spring.html

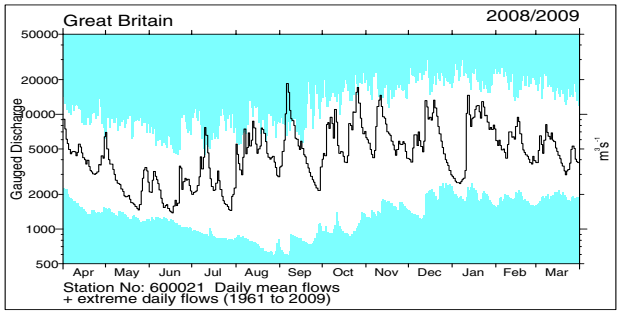
River flow . . . River flow . . .

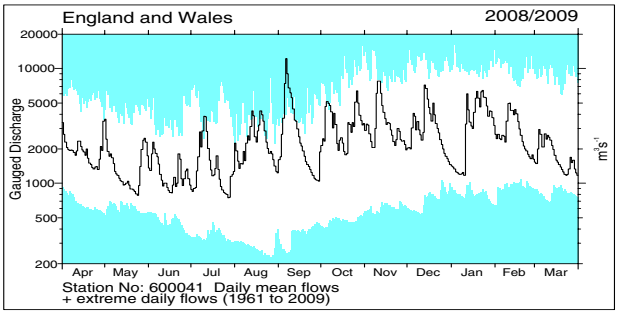


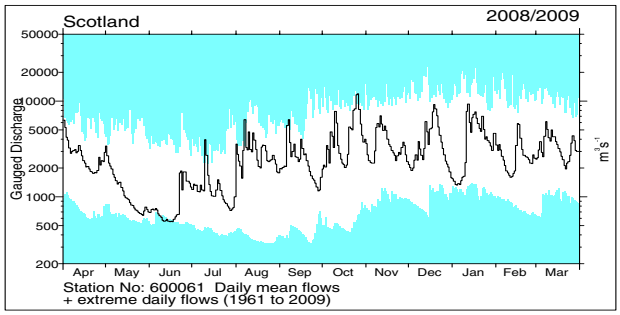
River flows

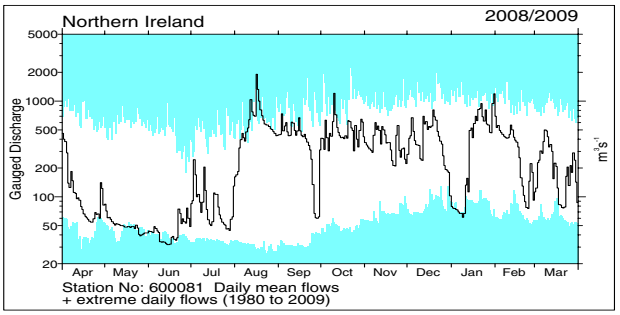
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

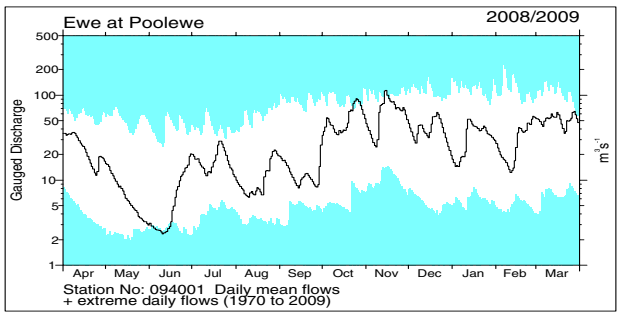
River flow . . . River flow . . .

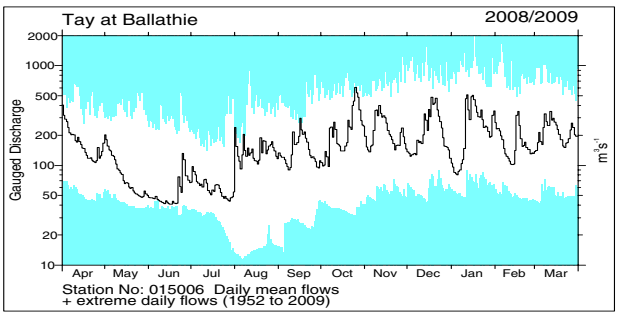


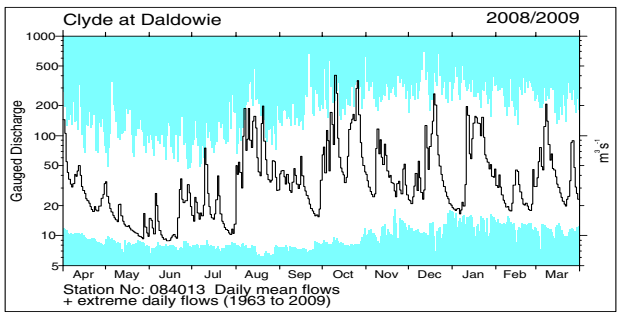


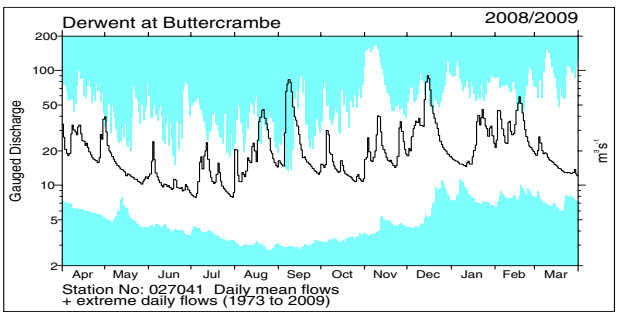


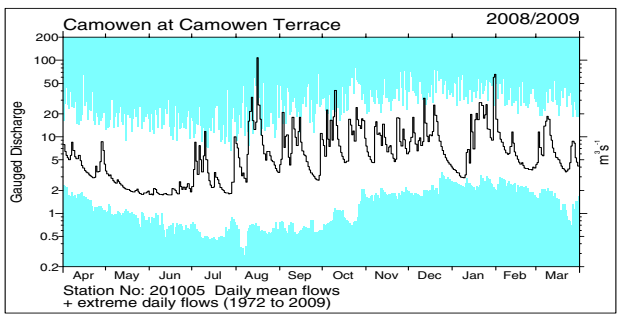


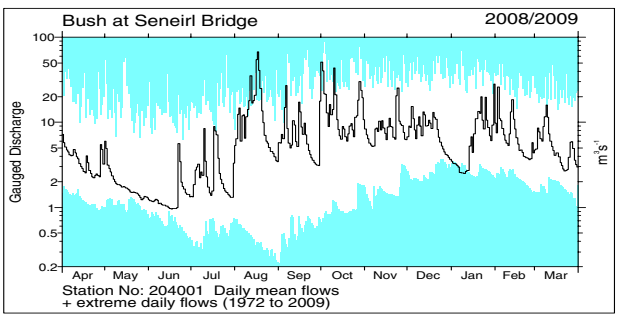








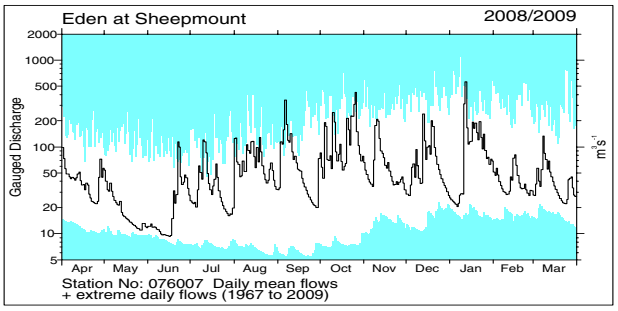


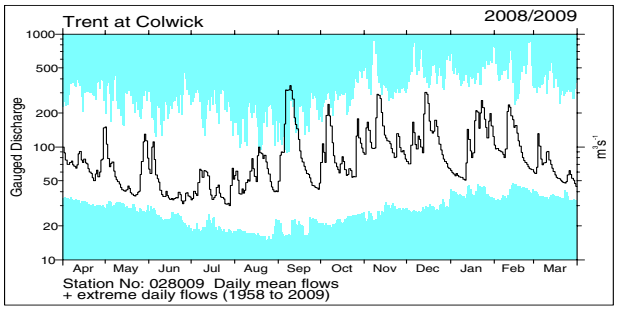


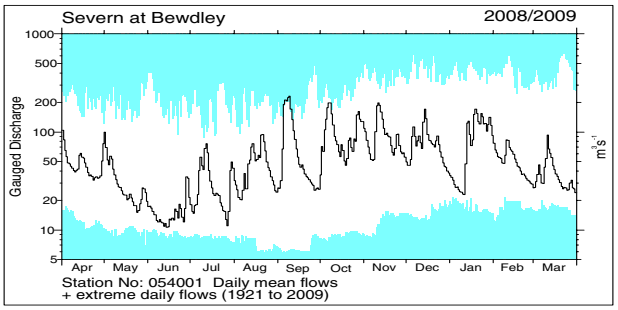
River flow hydrographs

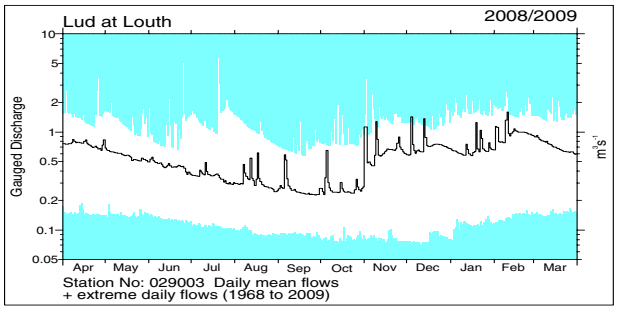
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2008 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

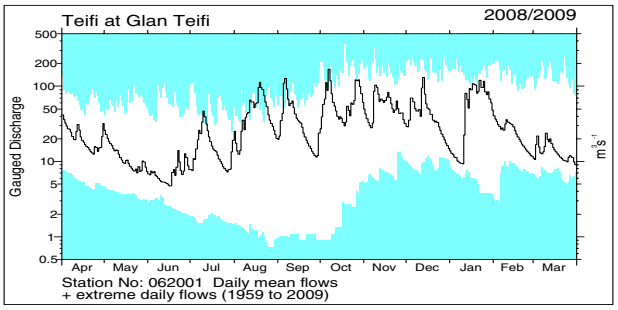
River flow . . . River flow . . .

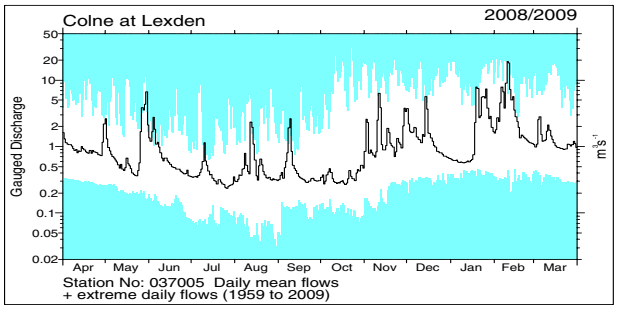


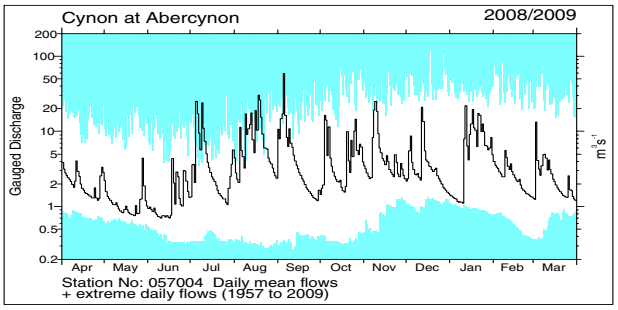


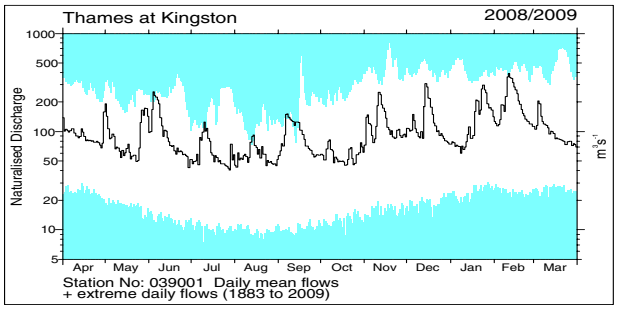


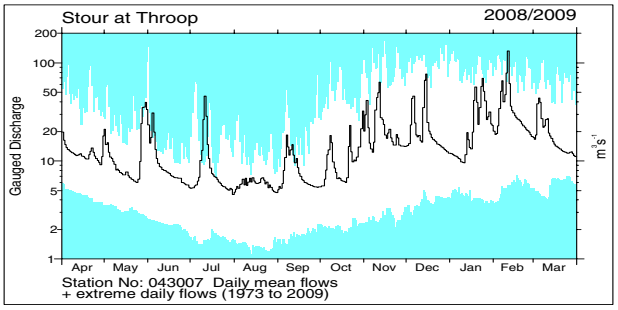


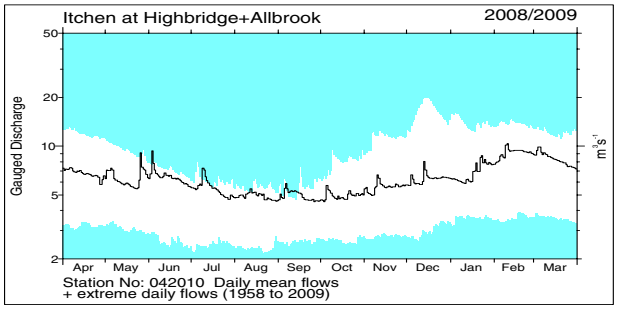












Notable runoff accumulations (a) Feb - March 2009, (b) Oct 2008 - March 2009, c) April 2008 - March 2009

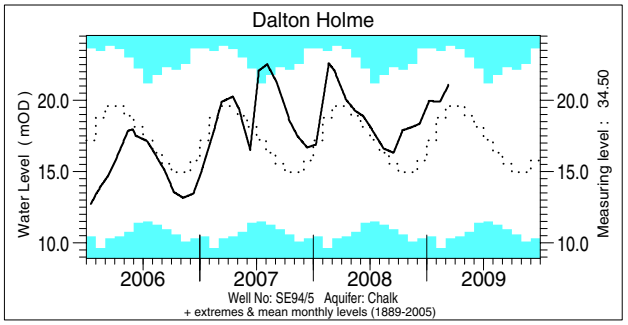
	River	%lta	Rank
a)	Colne	154	46/50
	Yscir	54	2/37
	Cynon	49	3/51
	Dee (Manley Hall)	48	3/72
	Ribble	42	3/49
	Luss	60	3/32
	Faughan	59	4/33

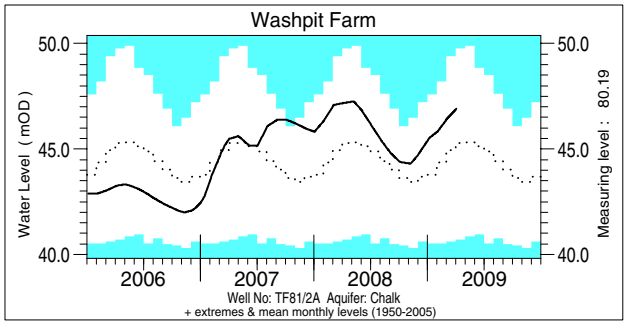
	River	%lta	Rank
b)	Forth	82	6/28
	Yscir	75	4/36
	Luss	81	4/30
	Lagan	70	5/36
	Annacloy	77	5/29

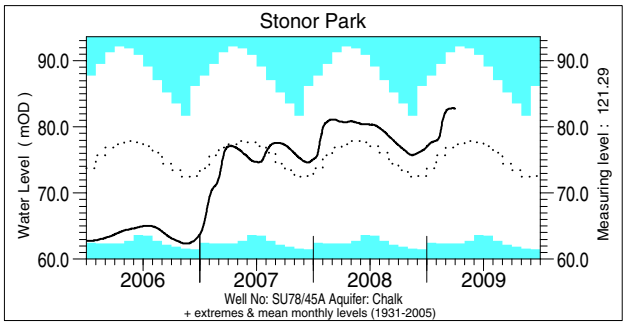
	River	%lta	Rank
c)	Tweed (Norham)	130	47/49
	Whiteadder	143	36/39
	Tyne (Bywell)	130	46/49
	Wharfe	164	53/53
	Coln	137	43/45
	Exe	131	48/52
	Brue	136	41/43

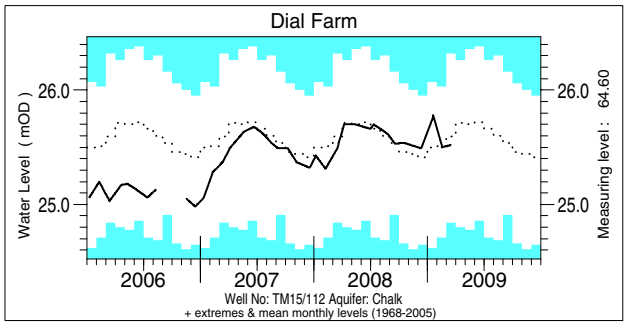
lta = long term average
Rank 1 = lowest on record

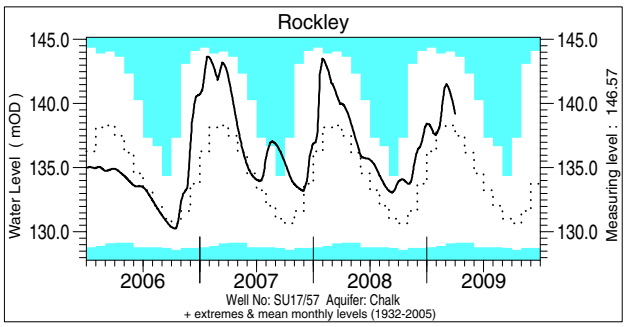
Groundwater . . . Groundwater

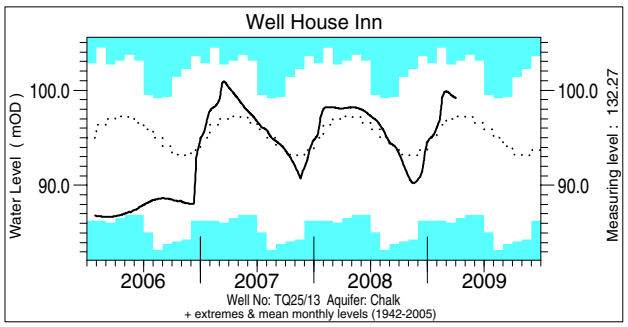


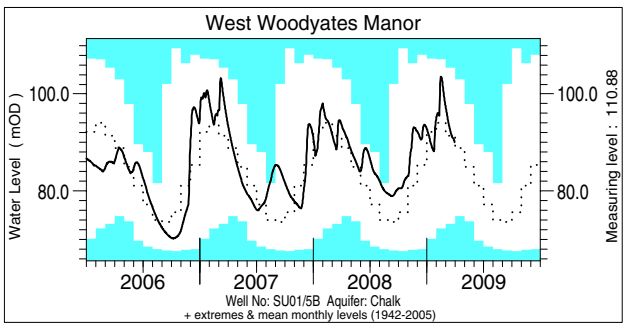


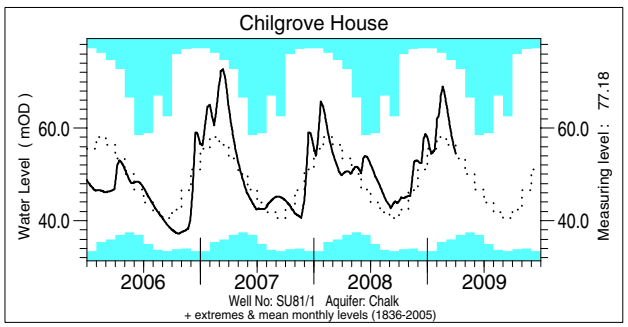


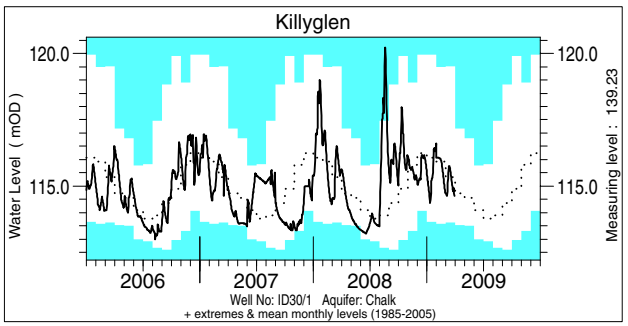


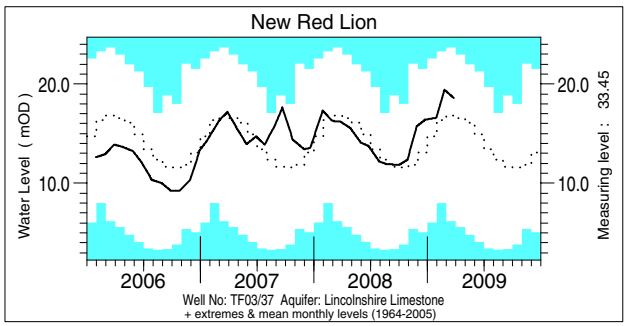






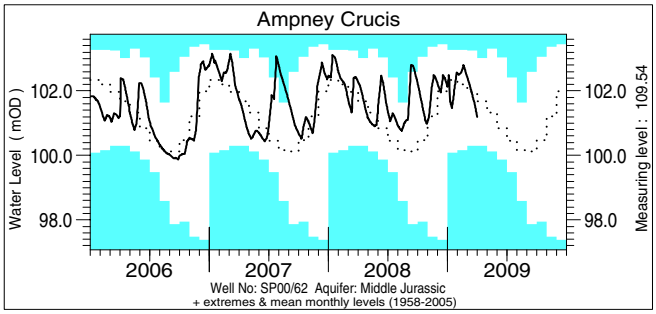


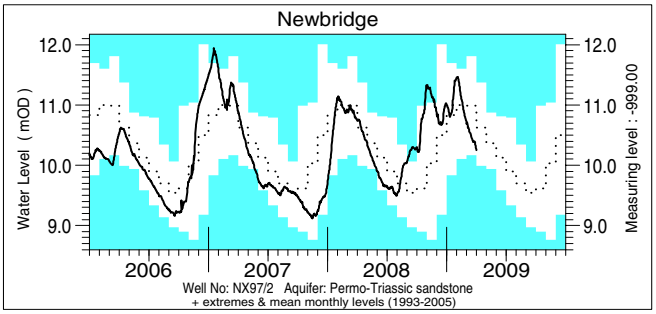


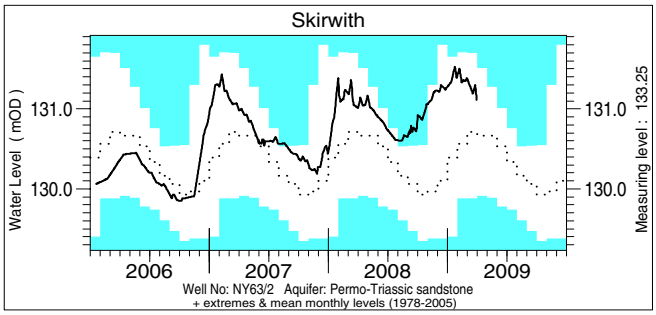


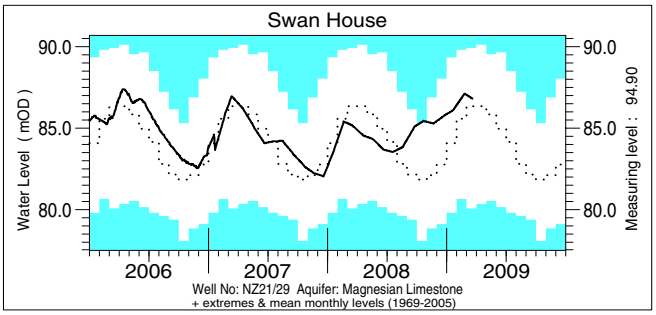
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

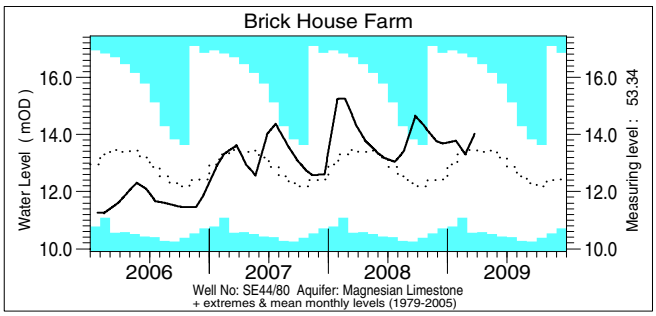
Groundwater . . . Groundwater

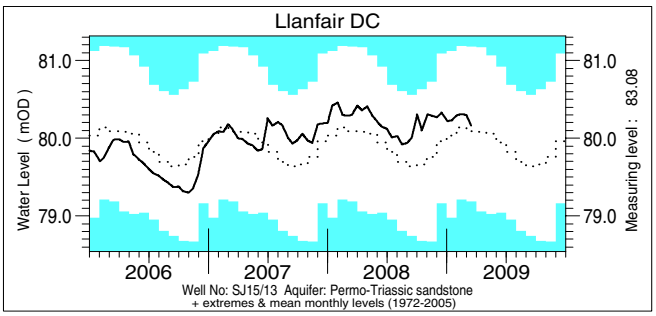


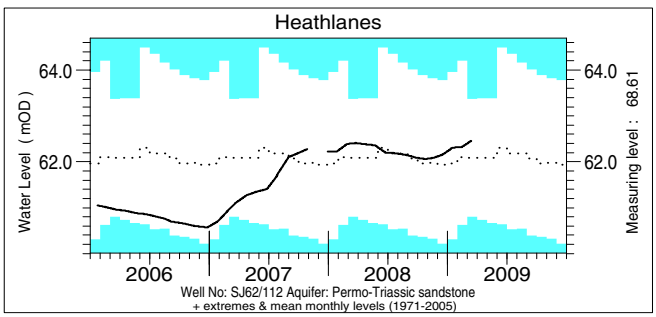


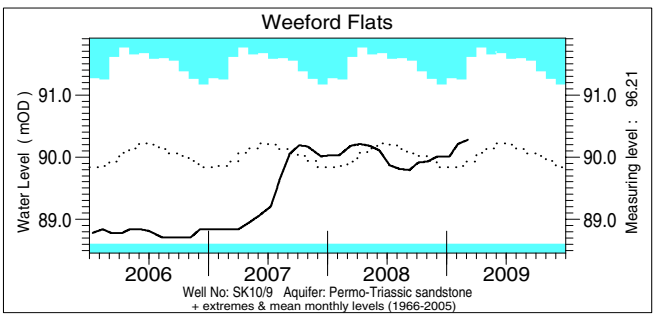


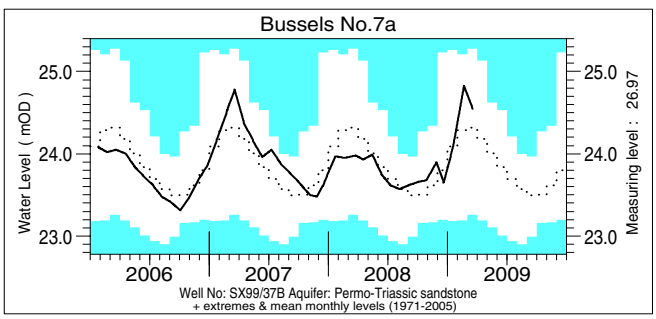


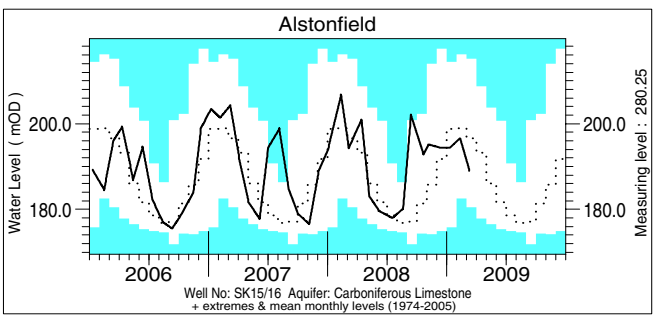












Groundwater levels March / April 2009

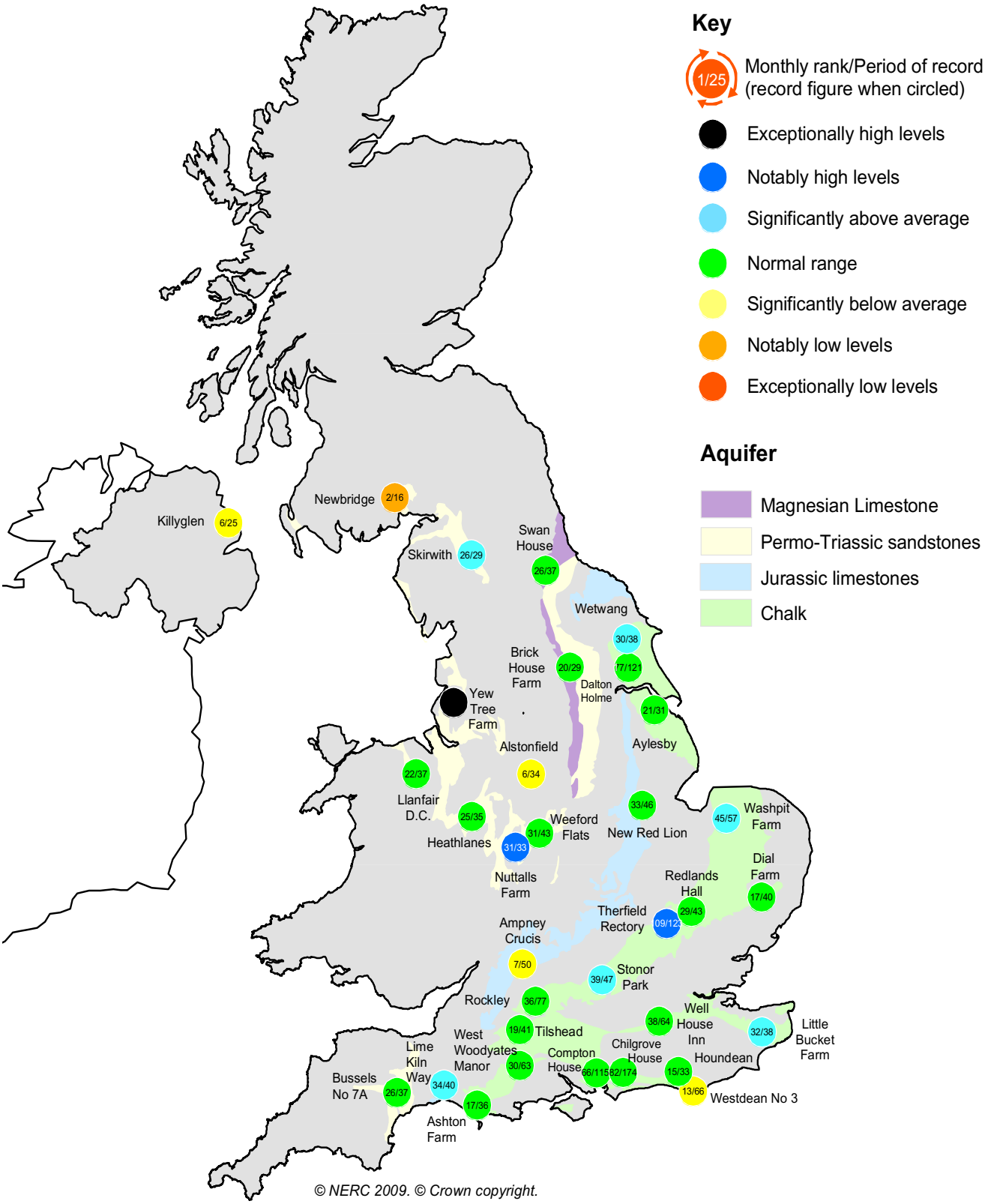
Borehole	Level	Date	Mar. av.
Dalton Holme	21.09	10/03	19.47
Washpit Farm	46.90	02/04	45.02
Stonor Park	82.74	01/04	76.67
Dial Farm	25.52	16/03	25.57
Rockley	139.21	01/04	138.44
Well House Inn	99.17	01/04	96.88
West Woodyates	90.08	31/03	90.73

Borehole	Level	Date	Mar. av.
Chilgrove House	54.52	31/03	55.50
Killyglen (NI)	114.62	30/03	115.51
New Red Lion	18.57	25/03	16.62
Ampney Crucis	101.20	01/04	102.00
Newbridge	10.25	01/04	10.87
Skirwith	131.11	31/03	130.69
Swan House	86.80	19/03	85.73

Borehole	Level	Date	Mar av.
Brick House Farm	14.02	23/03	13.34
Llanfair DC	80.16	15/03	80.07
Heathlanes	62.46	13/03	62.00
Weeford Flats	90.28	06/03	89.76
Bussels No.7a	24.55	17/03	24.31
Alstonfield	188.95	10/03	196.42

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



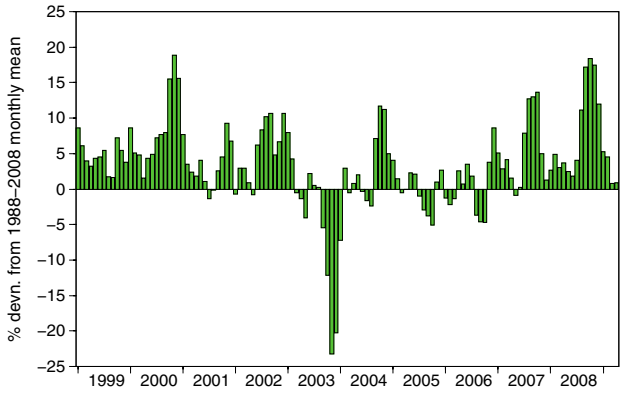
Groundwater levels - March 2009

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.

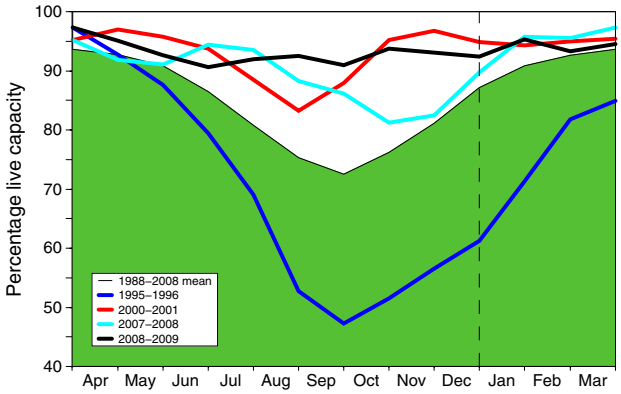
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

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)	2009 Feb	2009 Mar	2009 Apr	Apr Anom.	Min. Apr	Year* of min.	2008 Apr	Diff 09-08
North West	N Command Zone	• 124929	99	87	**85**	-8	77	1993	98	-13
	Vyrnwy	55146	100	92	**94**	-1	64	1996	100	-6
Northumbrian	Teesdale	• 87936	89	91	**96**	3	77	2003	100	-4
	Kielder	(199175)	(94)	(90)	**(90)**	-2	(81)	1993	(92)	-2
Severn Trent	Clywedog	44922	86	87	**95**	0	86	1996	100	-5
	Derwent Valley	• 39525	100	94	**95**	0	54	1996	100	-5
Yorkshire	Washburn	• 22035	97	95	**93**	0	70	1996	99	-6
	Bradford supply	• 41407	100	97	**94**	0	59	1996	100	-6
Anglian	Grafham	(55490)	(93)	(94)	**(95)**	4	(77)	1997	(90)	5
	Rutland	(116580)	(91)	(91)	**(93)**	3	(74)	1992	(96)	-3
Thames	London	• 202828	96	95	**97**	3	88	1990	97	0
	Farmoor	• 13822	78	86	**100**	5	84	1992	98	2
Southern	Bewl	28170	80	88	**92**	3	58	1989	100	-8
	Ardingly	4685	100	100	**100**	1	88	2006	94	6
Wessex	Clatworthy	5364	100	100	**98**	1	82	1992	100	-2
	Bristol WW	• (38666)	(98)	(98)	**(97)**	4	(71)	1992	(98)	-1
South West	Colliford	28540	100	100	**100**	15	58	1997	91	9
	Roadford	34500	99	97	**95**	10	37	1996	95	0
	Wimbleball	21320	100	100	**100**	4	78	1996	100	0
	Stithians	5205	100	100	**96**	3	52	1992	93	3
Welsh	Celyn and Brenig	• 131155	97	99	**100**	2	72	1996	100	0
	Brianne	62140	98	96	**97**	-1	90	1993	100	-3
	Big Five	• 69762	94	93	**95**	-1	78	1993	99	-4
	Elan Valley	• 99106	100	97	**98**	0	89	1993	100	-2
Scotland(E)	Edinburgh/Mid Lothian	• 97639	100	99	**100**	6	71	1998	100	0
	East Lothian	• 10206	99	99	**99**	0	95	1990	100	-1
Scotland(W)	Loch Katrine	• 111363	100	89	**98**	4	88	2001	93	5
	Daer	22412	99	99	**99**	1	93	2001	99	0
	Loch Thom	• 11840	96	94	**96**	-2	93	2001	96	0
Northern Ireland	Total+	• 61600	99	93	**87**	-2	83	2002	90	-3
	Silent Valley	• 20634	100	91	**82**	-2	57	2000	93	-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 1988-2008 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) was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology Wallingford (formerly the Institute of Hydrology - IH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the 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 Wallingford) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Rainfall

Most rainfall data are provided by the Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of the Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS*. Recent figures have been produced by the Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national and regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available by the Met Office in 2004; these have been adopted by the NHMP. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.

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.

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

Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

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OX10 8BB

Tel.: 01491 838800
Fax: 01491 692424
E-mail: nrfa@ceh.ac.uk

Selected text and maps are available on the WWW at
http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

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