Hydrological Summary

for the United Kingdom

August 2009

General

August was a cloudy, warm month with contrasting synoptic patterns making for a marked exaggeration in the normal north-west to south-east rainfall gradient across the UK. At the national scale the monthly rainfall total was appreciably above average but whilst northern and western regions were notably wet, rainfall totals were meagre in parts of southern, central and eastern England. Near-saturated late summer soils encouraged significant inflows to many upland reservoirs (e.g. in the Lake District and western Scotland) and estimated overall stocks in England & Wales, Scotland and Northern Ireland are close to, or above, their previous early autumn maxima. However, stocks declined considerably in many lowland impoundments resulting in some below average early Sep. levels (e.g. Bewl Water). High summer runoff, with a sequence of notable spates, typified western and northern rivers but river flow recessions continued in the English Lowlands and August runoff totals fell well below average in a few responsive lowland catchments. Spatially, the status of groundwater resources varies substantially but August levels in most index wells and boreholes were within the normal late-summer range. Levels are relatively depressed in a few aquifer outcrops in the English Lowlands – where notably dry late-August soils may delay the seasonal recovery of recharge rates.

Rainfall

For much of August, high pressure, extending from the continent, diverted rain-bearing Atlantic frontal systems away from south-eastern Britain. Correspondingly, wet, and often autumnal, weather prevailed across most western and northern regions. The latter half of the month saw a sequence of low pressure systems, including the remnant of Hurricane Bill, bring substantial pulses of rainfall to northern Britain. 24-hr rainfall totals exceeded 50mm in many localities on the 20/21st. Eskdalemuir (Dumfries and Galloway) reported 78mm and further rainfall (e.g. 65mm on the 30/31st) during a very wet end to the month contributed to a monthly total of 392mm – clearly eclipsing the previous August maximum. With new record August rainfall totals common in the west, Scotland registered its 3rd wettest August on record. By contrast, much of England, though afflicted by occasional thunderstorms, e.g. on the 6th (when 60mm was recorded at Holbeach, Lincs), reported extended sequences of dry days. August rainfall totals fell as low as 10mm (in Norfolk) and significant areas registered less than 50% of the monthly average. Provisional data indicate that Scotland registered its 2nd wettest summer (June-August) since 1956 – contributing to the wettest three-summer sequence for the UK in a series from 1914. Nonetheless, the 2009 summer rainfall fell appreciably below average in some, mostly coastal, areas of southern and eastern England and medium term (5-9 month) rainfall deficiencies are appreciable in many lowland catchments.

River Flows

The exceptional July rainfall helped ensure that river flows (in most index catchments) were notably high in early August but recessions then became re-established, and continued through much of the month in parts of southern Britain. To the north however, the recessions were soon reversed, heralding remarkable summer runoff rates later in the month; flood alerts were common across northern Britain during the final 10 days. Floodplain inundations were generally modest but the Forth (at Craigforth) reported its highest August daily mean flow since 1985 whilst the Tay and Nith recorded their 2nd highest August peak flows in 24 and 22 years respectively. Estimated outflows from Scotland and Northern Ireland were close to the late-August maximum during the latter half of the month and new maximum August runoff totals were established for the Luss Water and Cree. In contrast, end-of-summer flows were meagre in some responsive southern and eastern rivers; in Kent, the Gt. Stour registered its lowest end-of-August flows for a decade, flows were also relatively depressed in the Rother (Sussex) and Chelmer (Essex). In such rivers, largely restricted to southern Britain, August runoff fell below average and, commonly, runoff deficiencies are appreciable in the 3-8 month timeframes. In much of Scotland and Northern Ireland however, recent runoff has been abundant; the Nith, Cree, Mourne and Camowen were among those rivers where previous March-August runoff maxima have been eclipsed.

Groundwater

Throughout the spring and early summer, soil moisture deficits (smds) developed very erratically and, by late-July, soils were generally much wetter than normal. Exceptionally moist summer soil conditions persisted in western and northern regions through August but soils dried out considerably in the English Lowlands (where the outcrops of most major aquifers are concentrated). Entering September, smds in these areas were considerably above the end-of-summer average, particularly so in a band from Hants to Kent. As a consequence, replenishment to lowland aquifers during August was minimal (as is normally the case). Some significant recharge did occur in a number of western outcrop areas however. This is evidenced by the sharp rise in groundwater levels at Newbridge; the notable August increase at Alstonfield and the more modest rise at Ampney Crucis are primarily responses to the very wet July. Recharge patterns have been spatially and temporally very uneven during 2009; this is directly reflected in the late summer groundwater levels. During August levels in most index wells and boreholes were within the normal range but spatial variations, both regionally and locally, were significant. Levels in a few index wells were depressed, In the western Chalk, Tilshead reported its 2nd lowest August level on record but, generally, late-summer recessions tracked well above the drought range. Given typical autumn rainfall totals, the notably dry soils in south-east Britain will appreciably delay the seasonal onset of recharge; this could prove significant if rainfall through next winter is low.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

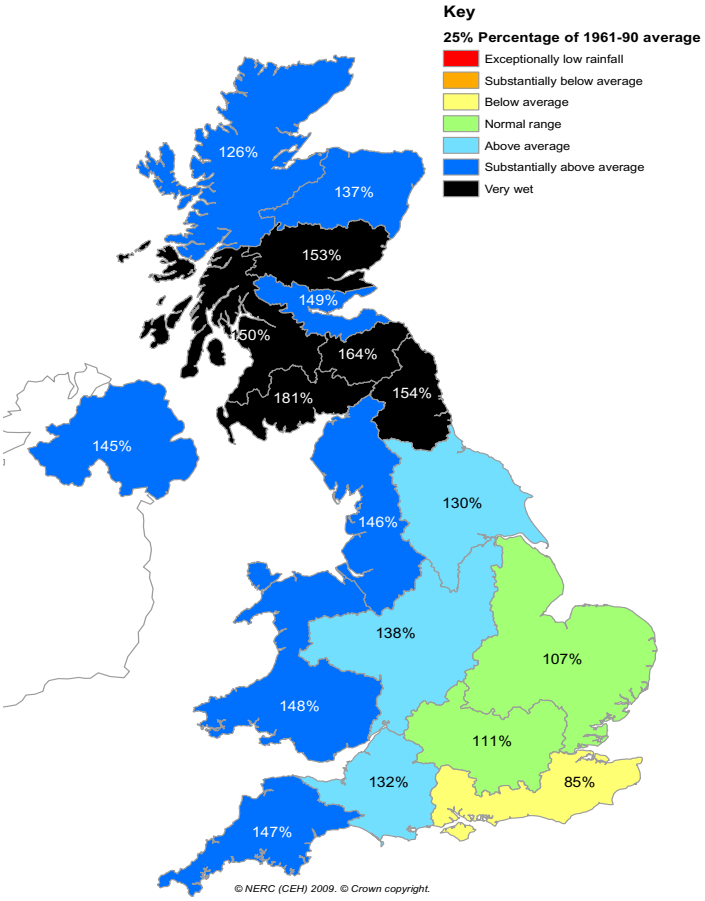
Area	Rainfall	Aug 2009	Jun 09 - Aug 09		Mar 09 - Aug 09		Jan 09 - Aug 09		Sep 08 - Aug 09	
England & Wales	**mm**	**65**	**268**		**416**		**558**		**927**	
	%	**85**	**132**	**5-10**	**104**	**2-5**	**101**	**2-5**	**102**	**2-5**
North West	mm	**139**	407		626		784		1344	
	%	**127**	146	10-20	120	10-20	109	2-5	110	5-10
Northumbrian	mm	**80**	326		461		579		960	
	%	**97**	154	15-25	114	5-10	106	2-5	111	2-5
Severn Trent	mm	**49**	254		386		490		813	
	%	**70**	138	5-10	107	2-5	101	2-5	106	2-5
Yorkshire	mm	**61**	260		393		500		824	
	%	**80**	130	5-10	101	2-5	95	2-5	99	2-5
Anglian	mm	**39**	168		258		356		585	
	%	**70**	107	2-5	86	2-5	92	2-5	97	2-5
Thames	mm	**49**	181		286		414		658	
	%	**83**	111	2-5	87	2-5	94	2-5	94	2-5
Southern	mm	**31**	137		256		427		720	
	%	**53**	85	2-5	77	5-10	91	2-5	92	2-5
Wessex	mm	**55**	236		364		522		849	
	%	**81**	132	2-5	100	<2	100	<2	99	2-5
South West	mm	**59**	333		544		776		1224	
	%	**68**	147	10-20	115	5-10	109	2-5	103	2-5
Welsh	mm	**96**	396		622		817		1398	
	%	**90**	148	5-15	114	2-5	104	2-5	104	2-5
Scotland	**mm**	**204**	**422**		**780**		**1021**		**1649**	
	%	**175**	**142**	**40-60**	**131**	**>100**	**120**	**10-20**	**112**	**20-30**
Highland	mm	**214**	424		892		1190		1985	
	%	**165**	126	10-20	131	>100	120	5-15	114	10-20
North East	mm	**101**	323		536		697		1072	
	%	**111**	137	5-10	116	5-10	110	5-10	104	2-5
Tay	mm	**170**	396		694		907		1373	
	%	**170**	153	15-25	132	25-40	118	5-10	107	2-5
Forth	mm	**158**	369		600		757		1194	
	%	**162**	149	10-20	124	10-20	111	2-5	104	2-5
Tweed	mm	**144**	380		554		709		1134	
	%	**160**	164	25-40	124	5-15	115	5-10	113	5-10
Solway	mm	**292**	541		850		1089		1764	
	%	**240**	181	>100	145	>100	130	50-80	123	>100
Clyde	mm	**293**	528		972		1233		1976	
	%	**206**	150	40-60	141	>100	123	10-20	113	10-20
Northern Ireland	**mm**	**162**	**349**		**618**		**787**		**1214**	
	%	**170**	**145**	**10-20**	**131**	**30-45**	**118**	**5-15**	**111**	**5-10**

% = 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 January 2009 are provisional.

Rainfall . . . Rainfall . . .

June - August 2009



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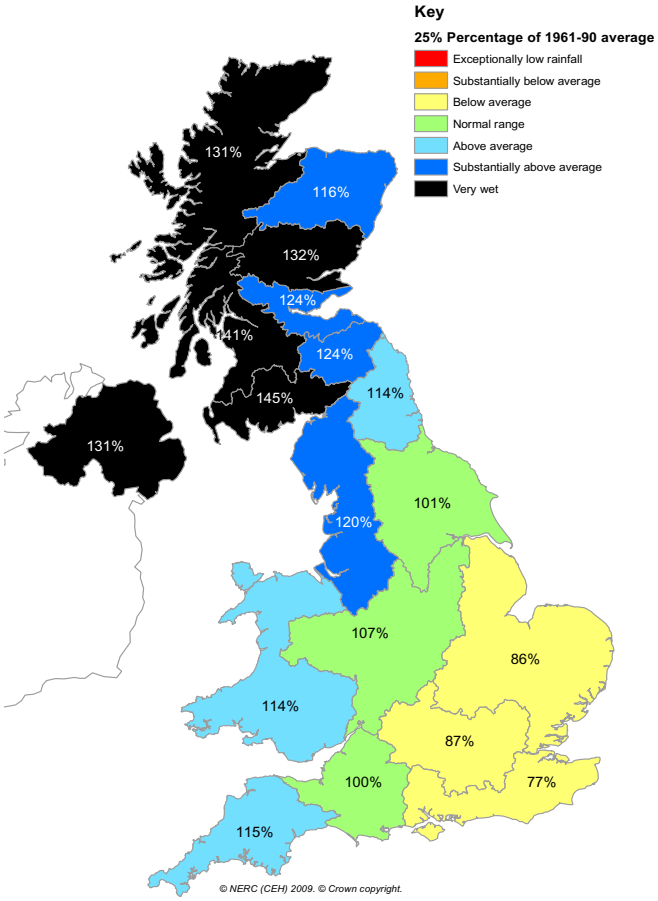
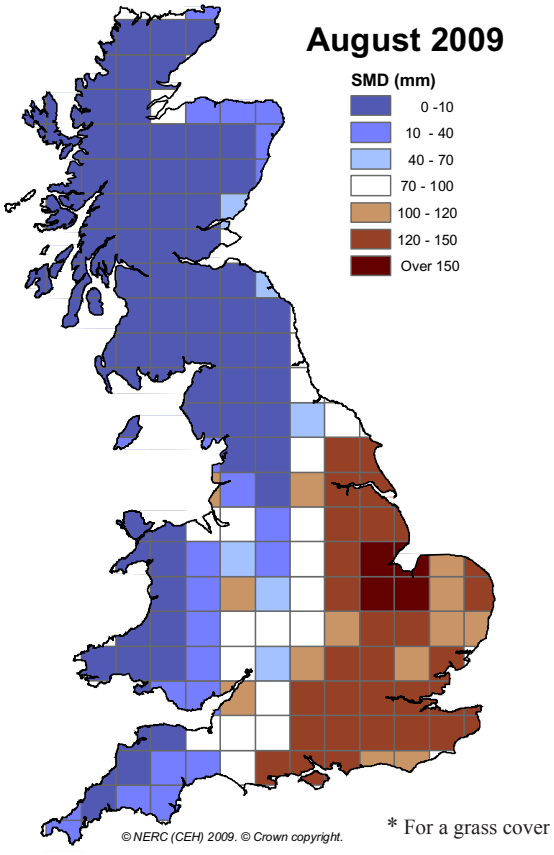


MORECS Soil Moisture Deficits *



* For a grass cover

Met Office Autumn 2009 forecast

Forecast for the Autumn 2009:
Issued 27 August 2009

Temperature
Temperatures are likely to be average or above average over most of Europe, including the UK.

Rainfall
For Europe, including the UK, at this stage there is no clear signal for the amounts of autumn rainfall.

Early indications for Winter 2009/10:
Issued 23 July 2009

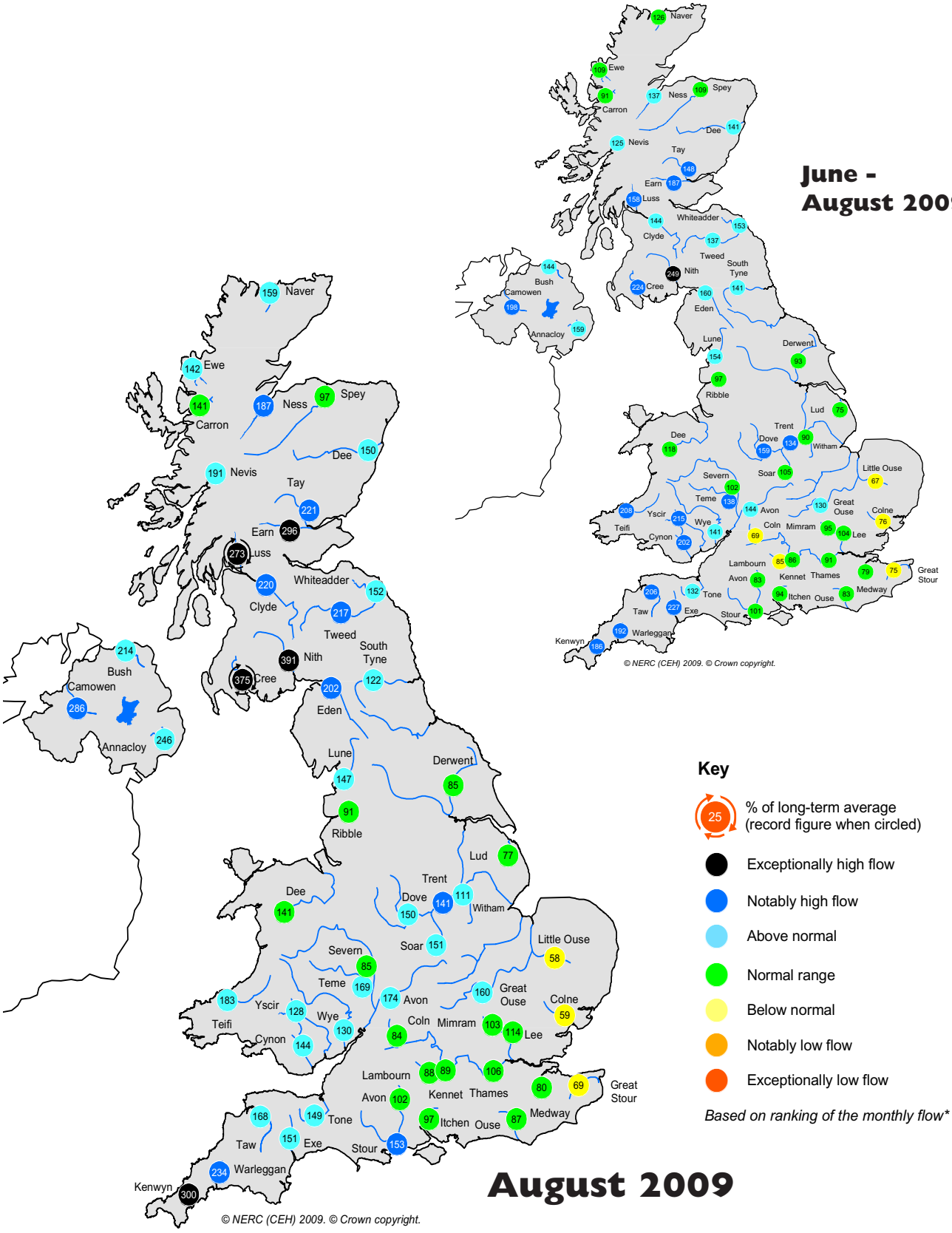
Temperature
Early indications are that winter temperatures are likely to be near or above average over much of Europe including the UK. For the UK, Winter 2009/10 is likely to be milder than last year.

Rainfall
Early indications are that winter precipitation is likely to be near or above average over much of northern Europe. For the UK, Winter 2009/10 is likely to be wetter than last year.

Updates and reviews of the forecast
The forecast for Autumn 2009 will be updated by 11 a.m. on 30 September 2009.
The winter forecast will be issued in September
For further details please visit:

http://www.metoffice.gov.uk/science/creating/monthsahead/seasonal/2009/autumn.html

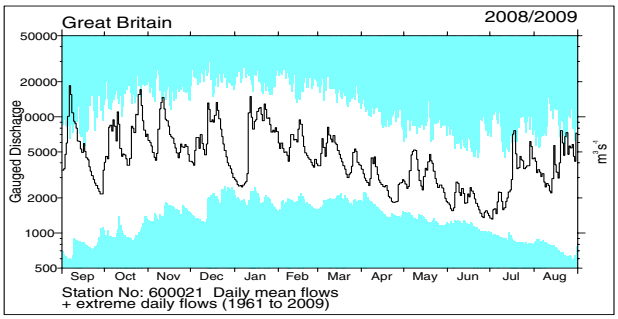
River flow . . . River flow . . .

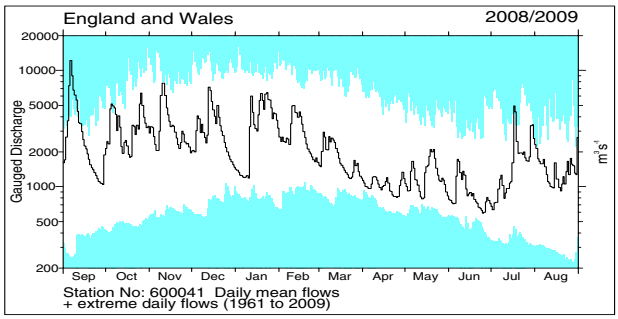


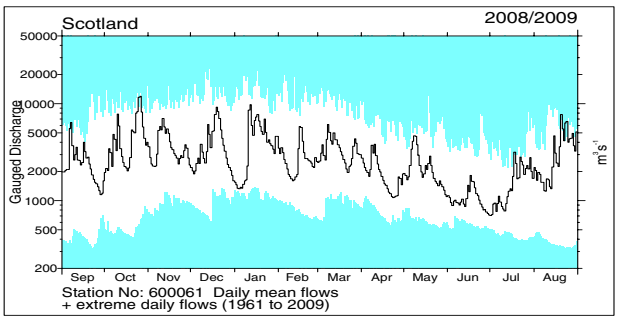
River flows

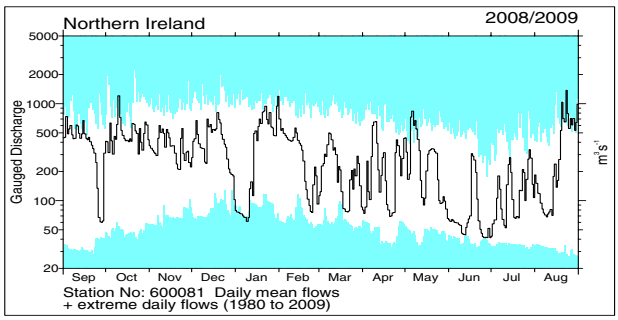
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

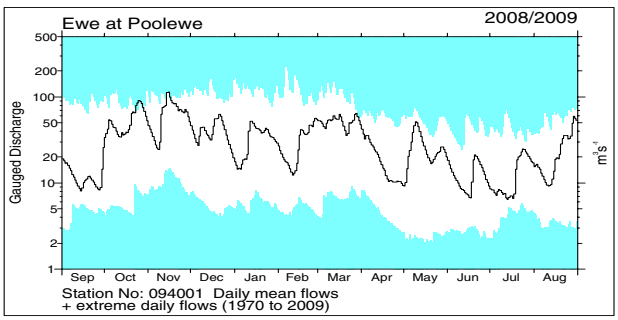
River flow . . . River flow . . .

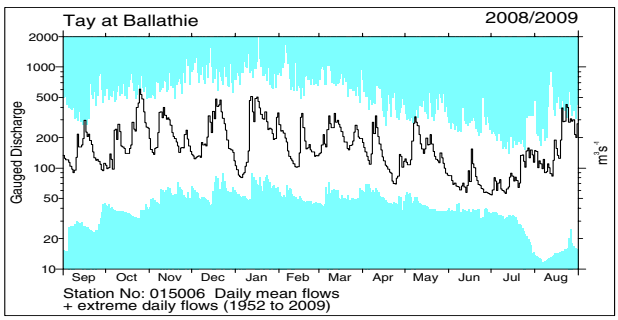


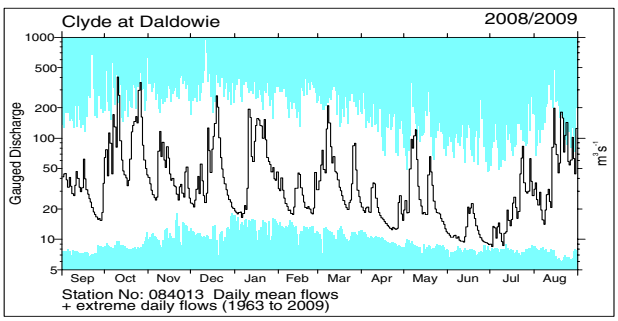


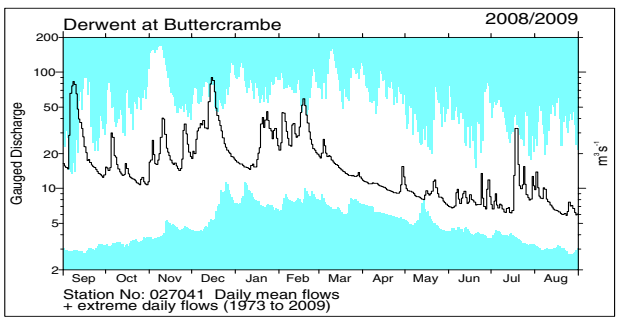


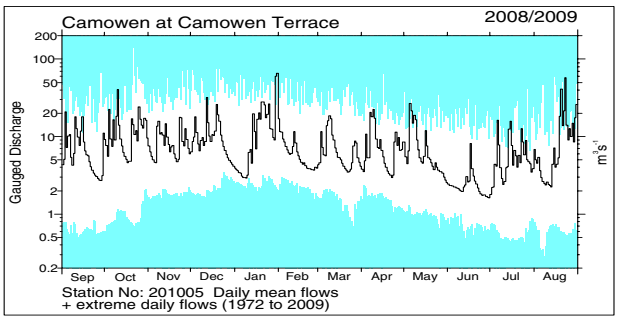


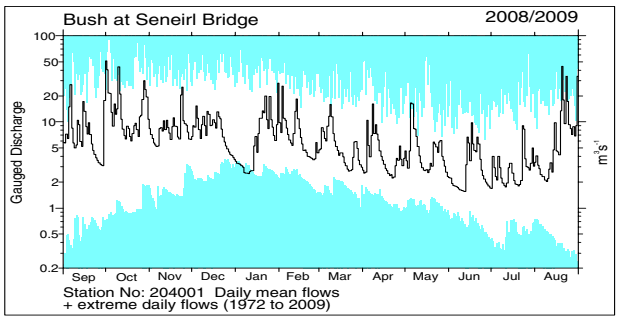








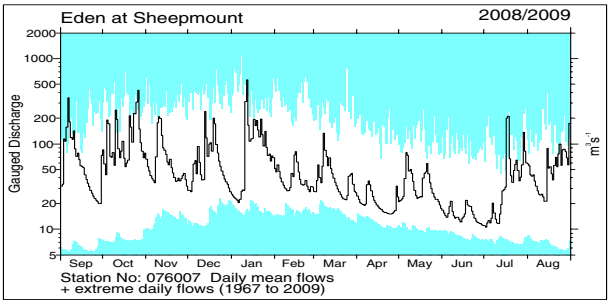


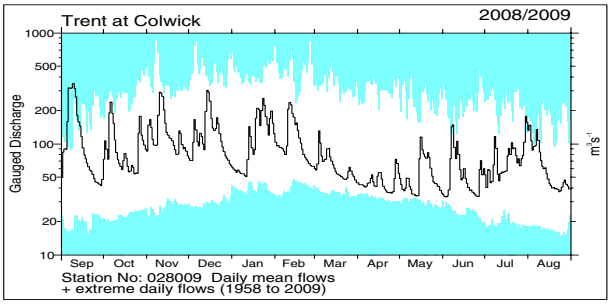


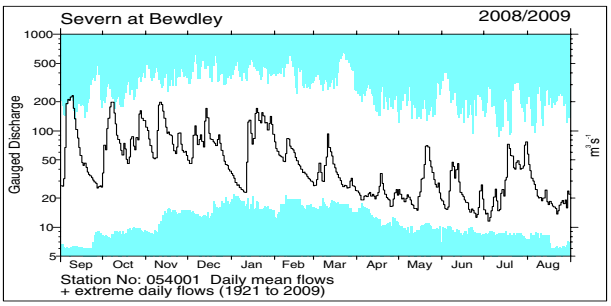
River flow hydrographs

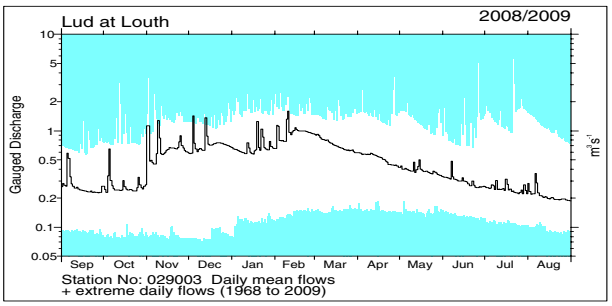
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to September 2008 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

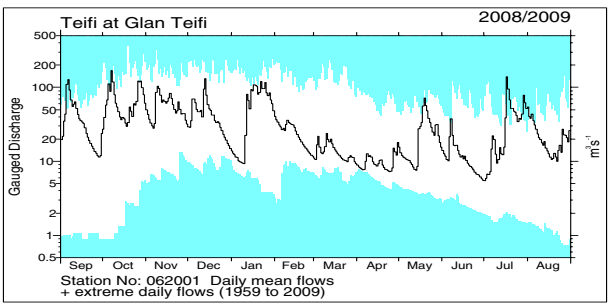
River flow . . . River flow . . .

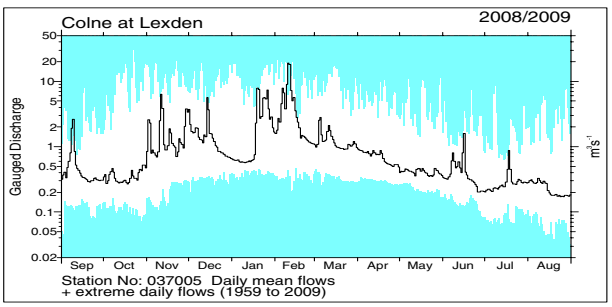


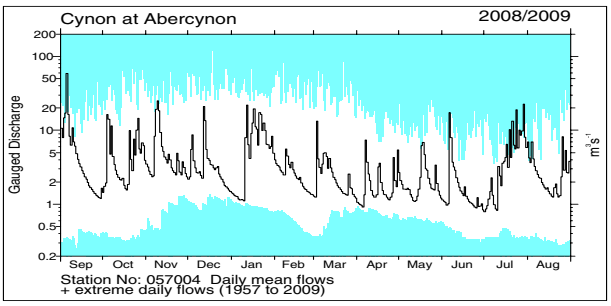


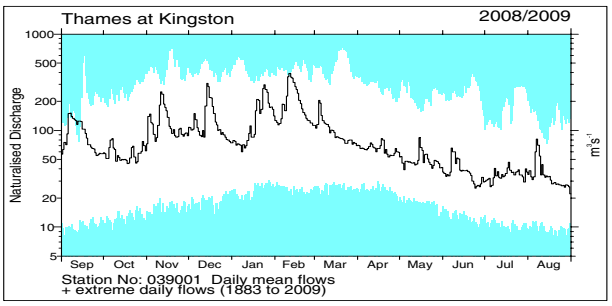


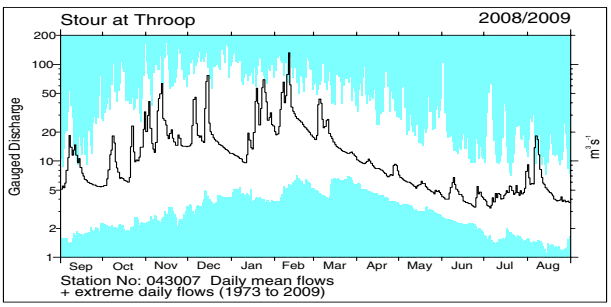


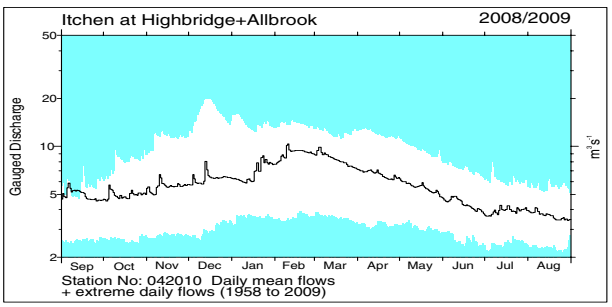












Notable runoff accumulations (a) June - August 2009, (b) March - August 2009

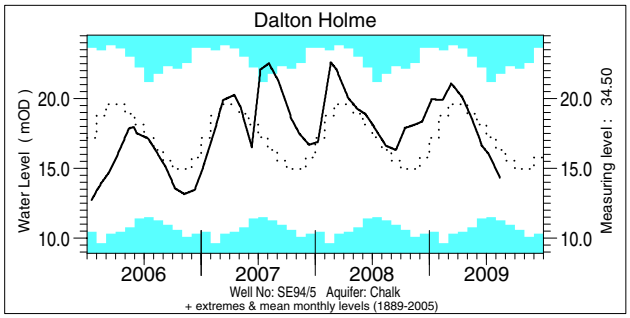
	River	%lta	Rank
a)	Ness	137	33/37
	Tay	148	53/57
	Forth	190	27/29
	Trent	134	47/51
	Dove	159	46/48
	Torne	160	34/38
	Dover Beck	140	32/35
	Exe	227	52/54
	Dart	158	47/51
	Warleggan	192	38/40

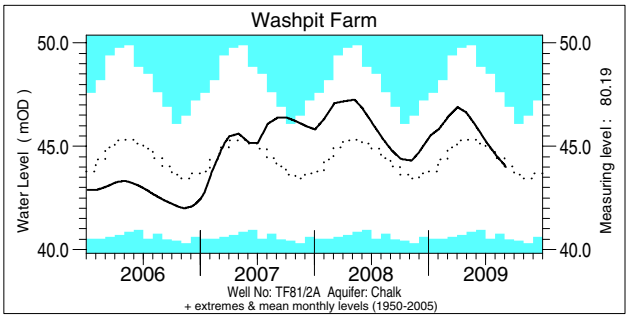
	River	%lta	Rank
a)	Kenwyn	186	38/41
	Teme	138	36/40
	Yscir	215	35/38
	Cynon	202	48/51
	Tawe	238	48/51
	Teifi	208	45/49
	Luss Water	158	29/31
	Annacloy	159	26/30

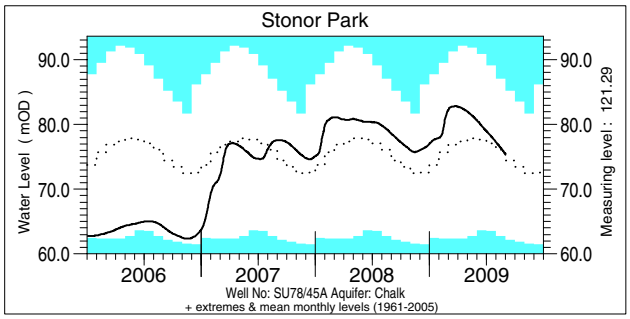
	River	%lta	Rank
b)	Nith	167	52/52
	Cree	165	46/46
	Nevis	123	23/27
	Camowen	152	37/37
	Mourne	147	27/27

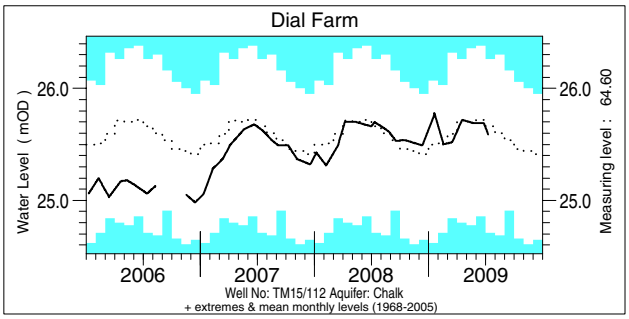
lta = long term average
Rank 1 = lowest on record

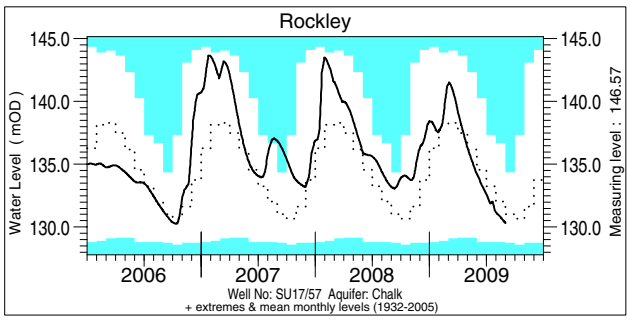
Groundwater . . . Groundwater

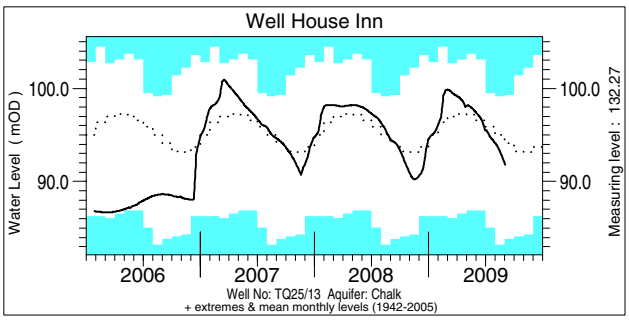


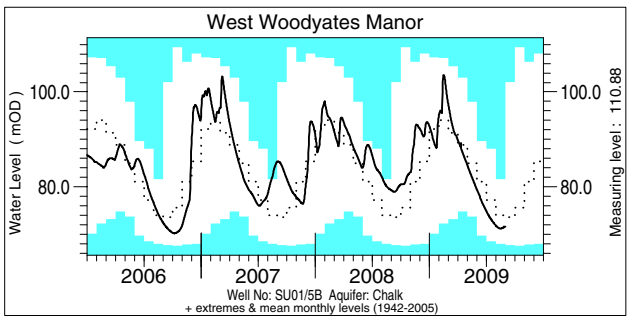


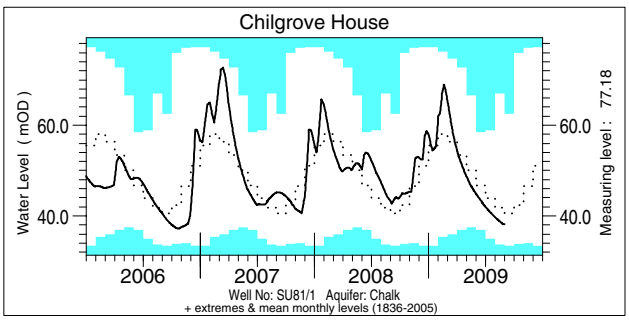


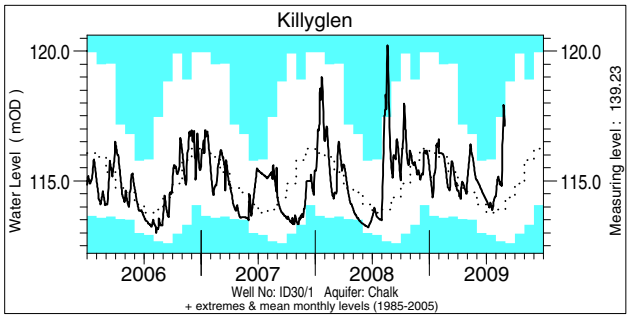


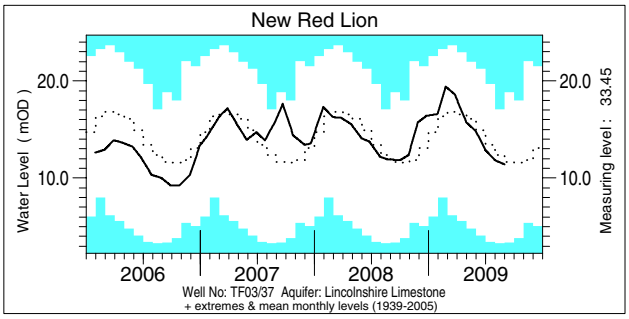






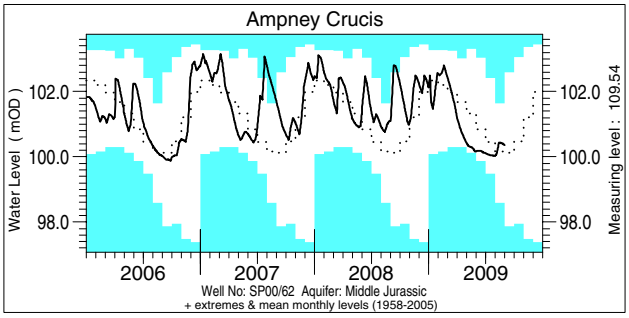


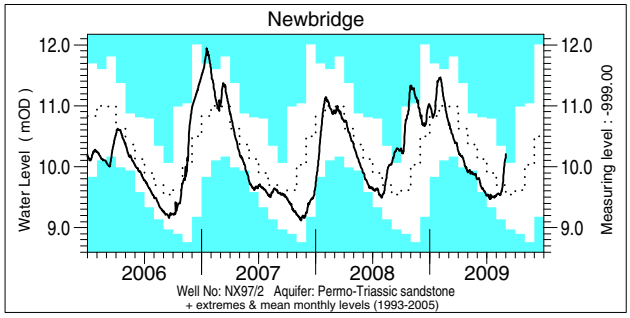


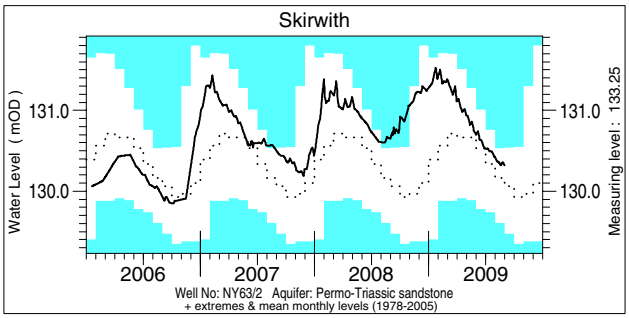


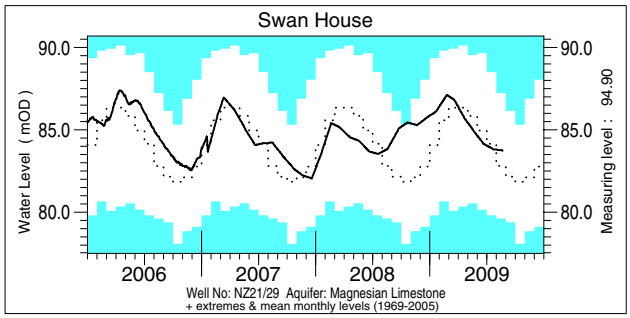
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

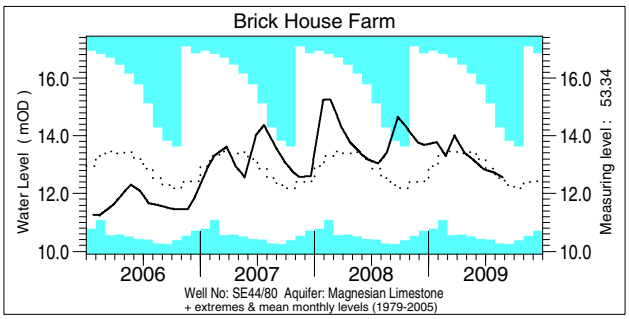
Groundwater . . . Groundwater

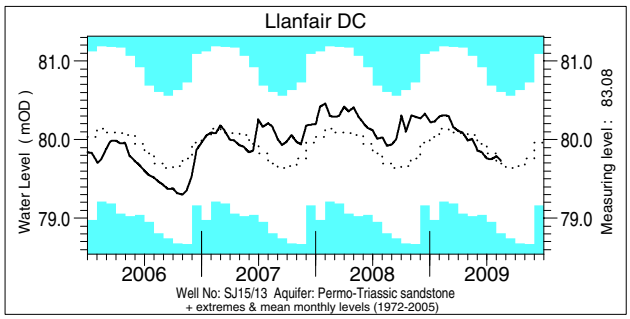


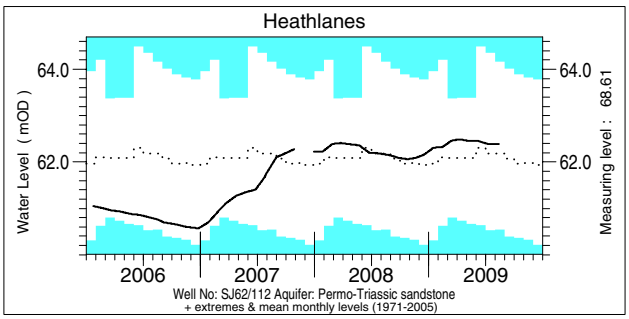


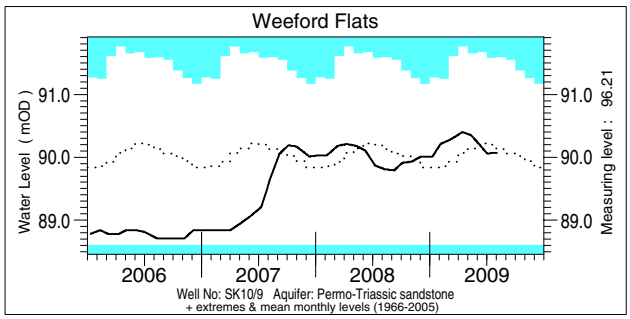


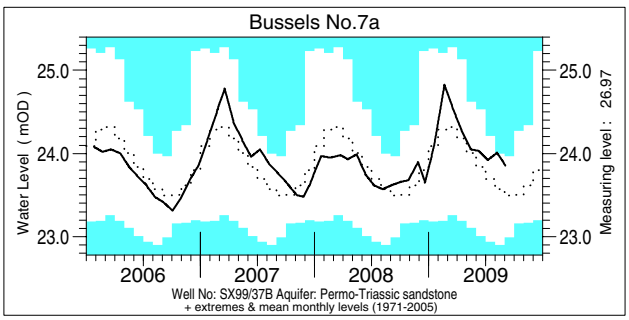


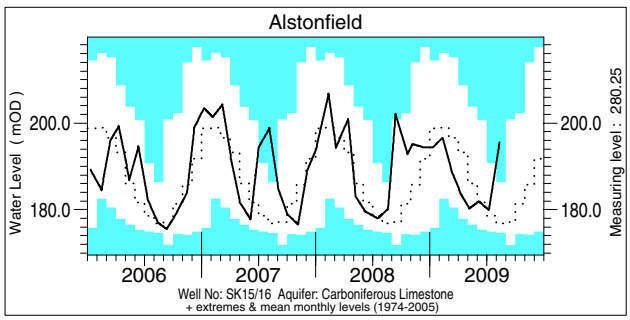












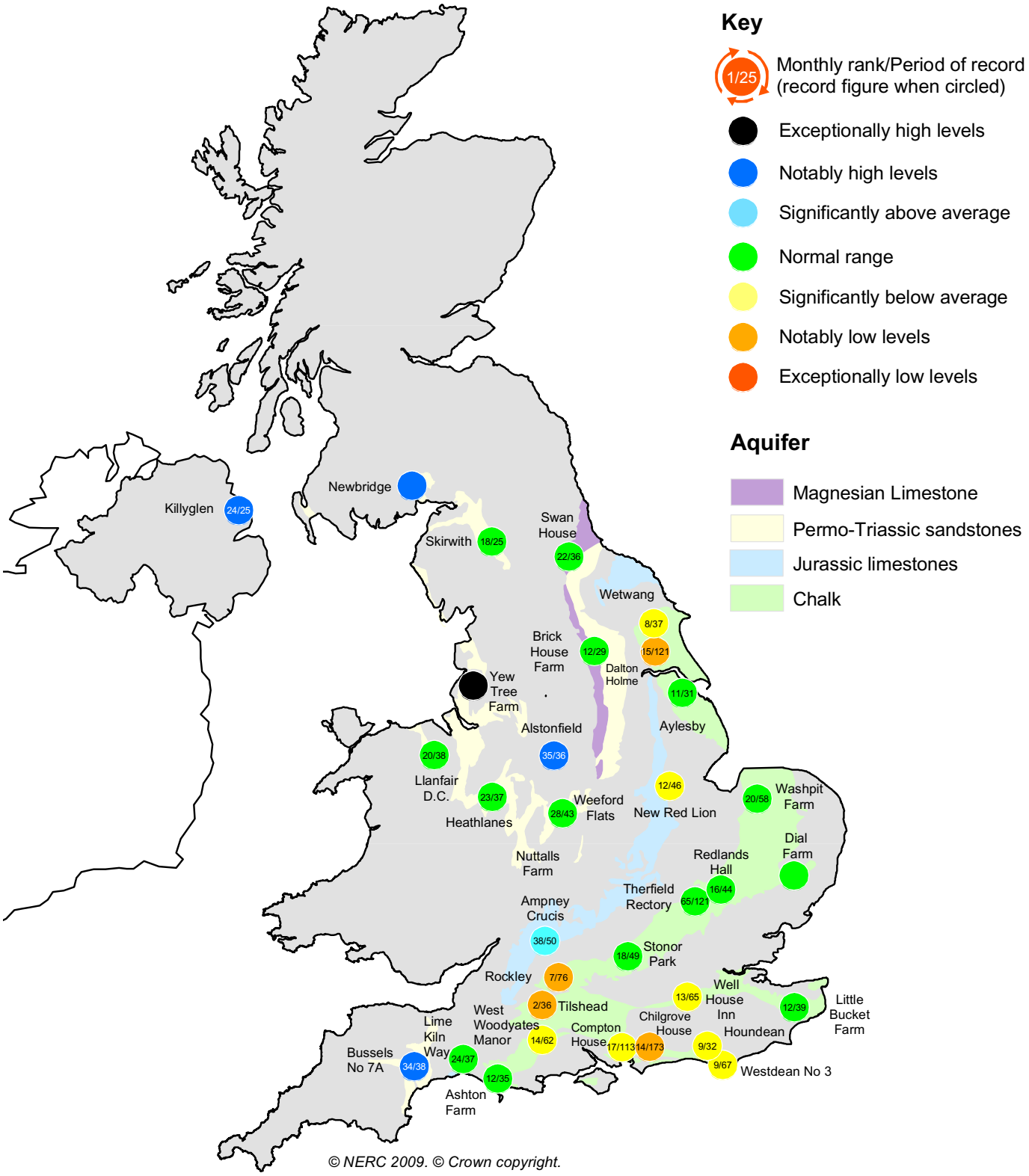
Groundwater levels August / September 2009

Borehole	Level	Date	Aug. av.
Dalton Holme	14.32	13/08	16.30
Washpit Farm	44.00	04/09	44.51
Stonor Park	75.36	01/09	75.86
Dial Farm	25.59	09/07	25.58
Rockley	130.32	01/09	132.10
Well House Inn	91.80	01/09	94.90
West Woodyates	71.57	31/08	74.12

Borehole	Level	Date	Aug. av.
Chilgrove House	38.24	31/08	41.74
Killyglen (NI)	117.12	30/08	114.02
New Red Lion	11.39	31/08	12.39
Ampney Crucis	100.35	01/09	100.22
Newbridge	10.21	31/08	9.65
Skirwith	130.32	31/08	130.19
Swan House	83.73	20/08	83.07

Borehole	Level	Date	Aug. av.
Brick House Farm	12.55	25/08	12.54
Llanfair DC	79.73	15/08	79.65
Heathlanes	62.39	12/08	62.10
Weeford Flats	90.07	03/08	89.82
Bussels No.7a	23.85	03/09	23.59
Alstonfield	195.53	10/08	178.11

Levels in metres above Ordnance Datum



Groundwater levels - August 2009

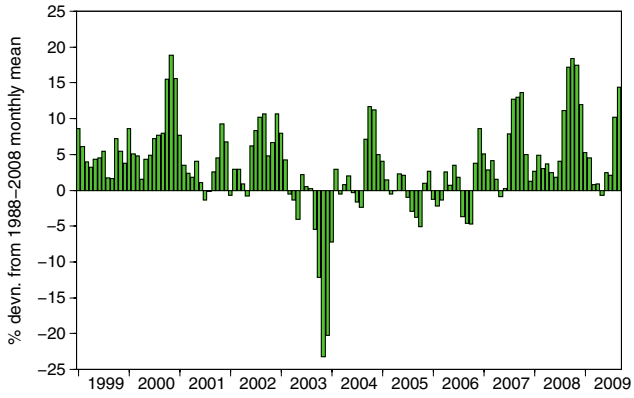
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

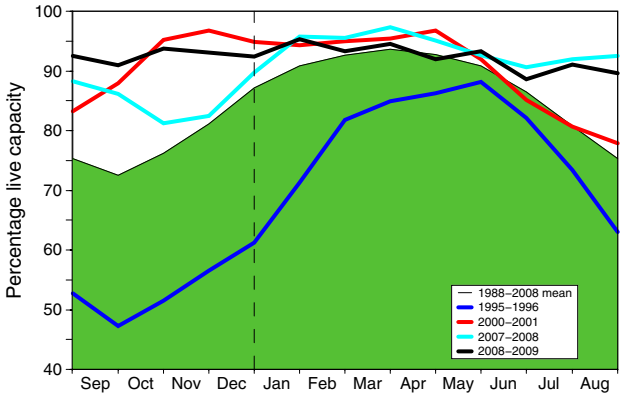
ii. Yew Tree Farm levels are now received quarterly.

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)	2009 Jul	Aug	Sep	Sep Anom.	Min Sep	Year* of min	2008 Sep	Diff 09-08
North West	N Command Zone	•	124929	78	82	**92**	36	24	1995	79	13
	Vyrnwy		55146	74	78	**77**	6	36	1995	94	-17
Northumbrian	Teesdale	•	87936	84	96	**95**	29	38	1995	91	4
	Kielder		(199175)	(91)	(94)	**(97)**	10	(66)	1989	(91)	6
Severn Trent	Clywedog		44922	100	100	**93**	17	38	1989	98	-5
	Derwent Valley	•	39525	79	84	**79**	12	34	1995	88	-9
Yorkshire	Washburn	•	22035	84	86	**81**	13	34	1995	97	-16
	Bradford supply	•	41407	78	84	**79**	13	21	1995	99	-20
Anglian	Grafham		(55490)	(92)	(90)	**(89)**	4	(59)	1997	(95)	-6
	Rutland		(116580)	(85)	(81)	**(78)**	-3	(66)	1995	(79)	-1
Thames	London	•	202828	95	95	**91**	12	62	1995	93	-2
	Farmoor	•	13822	95	96	**98**	6	64	1995	97	1
Southern	Bewl		28170	76	66	**57**	-13	38	1990	82	-25
	Ardingly		4685	86	83	**75**	2	47	1996	89	-14
Wessex	Clatworthy		5364	75	92	**93**	29	31	1995	89	4
	Bristol WW	•	(38666)	(77)	(86)	**(74)**	6	(43)	1990	(100)	-26
South West	Colliford		28540	97	95	**95**	24	43	1997	100	-5
	Roadford		34500	89	92	**89**	16	40	1995	97	-8
	Wimbleball		21320	89	94	**93**	23	40	1995	100	-7
	Stithians		5205	85	83	**82**	22	30	1990	76	6
Welsh	Celyn and Brenig	•	131155	97	95	**89**	8	49	1989	100	-11
	Brianne		62140	96	100	**100**	15	55	1995	100	0
	Big Five	•	69762	85	95	**96**	28	29	1995	98	-2
	Elan Valley	•	99106	95	100	**98**	21	46	1995	99	-1
Scotland(E)	Edinburgh/Mid Lothian	•	97639	93	89	**94**	17	45	1998	94	0
	East Lothian	•	10206	97	100	**100**	18	63	1989	99	1
Scotland(W)	Loch Katrine	•	111363	84	82	**100**	32	50	2000	77	23
	Daer		22412	93	90	**98**	25	41	1995	99	-1
	Loch Thom	•	11840	95	95	**96**	17	58	1997	95	1
Northern Ireland	Total⁺	•	56920	86	93	**96**	22	40	1995	87	9
	Silent Valley	•	20634	85	93	**97**	30	33	2000	97	0

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

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2008 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.
The Northern Ireland total⁺ has been revised to 56920 Ml as of September 2009.

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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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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