Hydrological Summary
for the United Kingdom

March 2010

General

Rainfall patterns in March were very variable – both spatially and through the month; the first three weeks were largely notably dry but very wet conditions then dominated into early April. The exceptionally dry winter and early spring in parts of Scotland (the west particularly) is reflected in the modest early spring reservoir stocks for a number of major reservoirs (Loch Katrine and Loch Thom both reported their lowest early April stocks in 17-year series; but stocks thence recovered briskly). Overall stocks for England & Wales were marginally above the early April mean but appreciably below average in a few major impoundments (e.g. in north-west England). Spate conditions and flood alerts were common at the beginning and the end of March but sustained recessions resulted in some notable seasonal minima around mid-month. Accumulated runoff totals over the last four months display wide geographical differences with large deficiencies characterising much of northern and western Britain (parts of Northern Ireland also). March rainfall across the major aquifers varied markedly and, with soil moisture deficits developing unevenly, groundwater replenishment was spatially very variable. Nonetheless most groundwater levels in index wells remain within, or above, the normal early spring range. With evaporation rates (and smds) increasing, rainfall over the next 4-6 weeks may prove particularly influential in relation to the water resources outlook for the summer.

Rainfall

With high pressure dominating synoptic patterns throughout early March, weather conditions were generally settled with penetrating frosts (in Scotland especially) and some notably dry episodes (Wallingford registered <5mm of rain over the first 18 days). From around the 19th active frontal systems became more influential with gales and blizzards affecting many areas during the final week. Many catchments recorded precipitation on each of the last 12 days with some exceptional totals on the 29th and 30th (when 48-hr totals reached 90mm in coastal areas of Antrim). Snow caused major transport disruption in Northern Ireland and Scotland (the A9 and the East Coast Main Line were both closed and 45cm of lying snow reported for Aviemore on the 31st). The snow contributed to notably high March precipitation totals in parts of SE Scotland and NE England (and in Antrim); the Tweed registered its 2nd wettest March since 1979. By contrast much of the Midlands and north-west Scotland was decidedly dry with totals falling below 50% of average in a few areas. Medium-term rainfall deficiencies continue to build across large parts of the country, most notably in Scotland which, provisionally, recorded its fourth driest Dec-March since 1940; much of western Scotland recorded its lowest rainfall in this timeframe since 1969. However, a wet late autumn helped ensure that winter half-year (Oct-Mar) rainfall totals were within the normal range for all regions (albeit still considerably below average in western Scotland).

River Flow

March river flows exhibited an exceptionally wide range in many parts of the UK. Within-month hydrological variability achieved an extreme expression in Northern Ireland where mid-month flows were close to March minima (e.g. in the Mourne and Faughan) but thereafter a dramatic recovery resulted in exceptional early spring peaks around the 31st – the Bush, Lagan and Annacloy were among those rivers eclipsing previous March maximum flows. Flood alerts were common and widely distributed during the last few days of the month (and continuing into April) but March runoff anomalies showed only limited spatial coherence. Generalising broadly, mean flows were above average throughout the English Lowlands and much of north-east Britain (in eastern Scotland the Deveron and Lossie registered new March maxima) but were seasonally depressed in many western catchments (the Welsh Dee reported its 2nd lowest March runoff since 1962). Regional runoff contrasts are more marked, and of greater water resources significance, when accumulations over the Dec-March period are considered. Accumulated runoff is very depressed for rivers draining parts of Northern Ireland and the western Highlands (a new Dec-March minimum was established for the Luss Water) – contributing to 3rd lowest runoff since 1969, in this timeframe, for Scotland as a whole. With a few exceptions, longer term runoff accumulations (>8 months) are within, or above, the normal range.

Groundwater

Soil moisture deficits began to build through the first half of March but the subsequent notably wet interlude generally resulted in soils at, or close to, saturation entering April. March rainfall totals were well below average across many outcrops of the Permo-Triassic sandstones in the Midlands and much of the eastern Chalk. Modest late-winter and early spring recharge produced relatively depressed March groundwater levels in a few responsive index wells (e.g. Alstonfield in the Carboniferous Limestone) and exceptionally low levels were reported for Newbridge (in the PTS of Dumfries and Galloway) following the notably dry winter (correspondingly, depressed groundwater may be expected in many superficial deposits in Scotland). Elsewhere however, the early spring recharge – concentrated in late March and early April – ensured that groundwater levels are above average across most outcrop areas of the principle aquifers, and recoveries are underway in even the slowest responding wells (e.g. in the deep Therfield well to the north of London). The dry and warm spell in early April may well signal an end to the recharge season in the English Lowlands.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

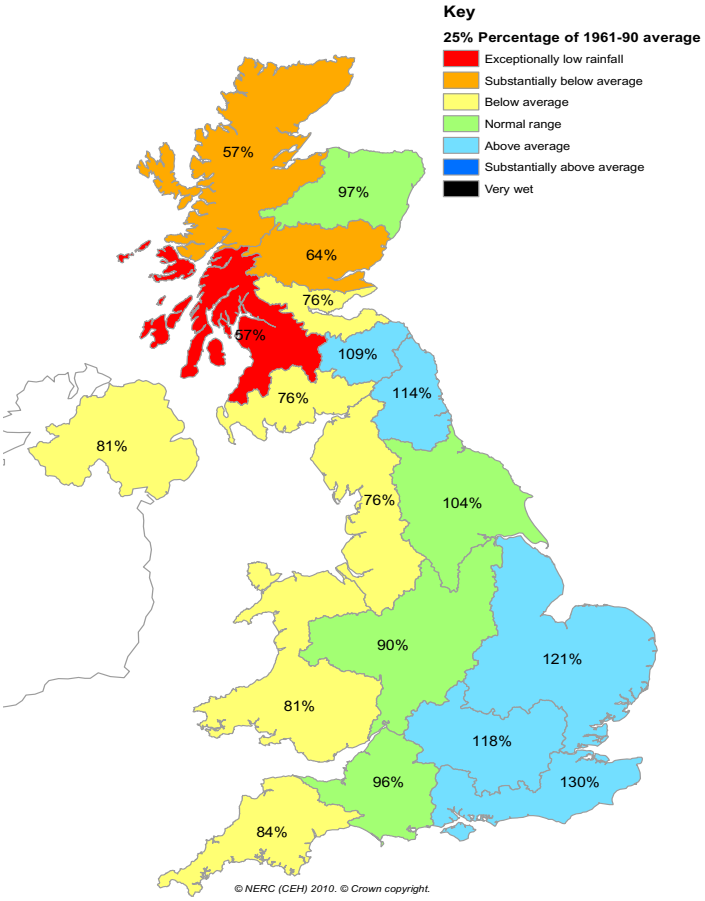
Area	Rainfall	Mar 2010	Dec 09 - Mar 10	RP	Oct 09 - Mar 10	RP	Jul 09 - Mar 10	RP	Apr 09 - Mar 10	RP
England & Wales	**mm**	**65**	**310**		**582**		**822**		**984**	
	%	**89**	**96**	**2-5**	**116**	**5-10**	**114**	**2-5**	**109**	**2-5**
North West	mm	**87**	321		715		1090		1306	
	%	**90**	76	5-10	106	2-5	110	2-5	107	2-5
Northumbrian	mm	**100**	338		600		887		1047	
	%	**140**	114	5-10	130	20-30	130	25-40	121	10-20
Severn Trent	mm	**47**	231		426		632		805	
	%	**76**	87	2-5	106	2-5	107	2-5	105	2-5
Yorkshire	mm	**70**	301		550		771		932	
	%	**102**	104	2-5	124	5-10	118	5-10	112	2-5
Anglian	mm	**35**	231		371		515		618	
	%	**76**	121	2-5	123	5-10	113	2-5	102	2-5
Thames	mm	**47**	283		482		637		758	
	%	**83**	118	2-5	130	5-10	118	2-5	108	2-5
Southern	mm	**61**	365		649		784		891	
	%	**97**	130	5-10	145	10-20	126	5-10	114	2-5
Wessex	mm	**56**	309		594		803		939	
	%	**80**	96	2-5	122	5-10	118	2-5	110	2-5
South West	mm	**84**	406		761		1099		1298	
	%	**84**	84	2-5	105	2-5	112	2-5	109	2-5
Welsh	mm	**97**	414		852		1223		1461	
	%	**89**	81	5-10	108	2-5	111	2-5	109	2-5
Scotland	**mm**	**100**	**360**		**789**		**1273**		**1547**	
	%	**78**	**66**	**10-20**	**92**	**2-5**	**105**	**2-5**	**105**	**2-5**
Highland	mm	**114**	374		835		1366		1673	
	%	**72**	57	10-20	80	2-5	94	2-5	96	2-5
North East	mm	**70**	342		679		1025		1231	
	%	**84**	97	2-5	121	10-20	125	35-50	120	25-40
Tay	mm	**66**	316		737		1162		1435	
	%	**59**	64	10-20	98	2-5	110	2-5	111	5-10
Forth	mm	**90**	313		641		1057		1266	
	%	**92**	76	5-10	99	2-5	113	5-10	111	5-10
Tweed	mm	**126**	382		679		1061		1220	
	%	**153**	109	2-5	125	10-20	132	>100	122	25-40
Solway	mm	**128**	396		863		1432		1711	
	%	**107**	76	5-10	104	2-5	121	20-35	119	35-50
Clyde	mm	**107**	370		893		1495		1839	
	%	**70**	57	20-30	87	2-5	102	2-5	105	2-5
Northern Ireland	**mm**	**99**	**322**		**648**		**988**		**1258**	
	%	**109**	**81**	**5-10**	**105**	**2-5**	**112**	**5-10**	**115**	**10-20**

% = 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 October 2009 are provisional. **The significant proportion of snowfall through the winter implies that the precipitation totals are likely to be underestimates.**

Rainfall . . . Rainfall . . .

December 2009 - March 2010



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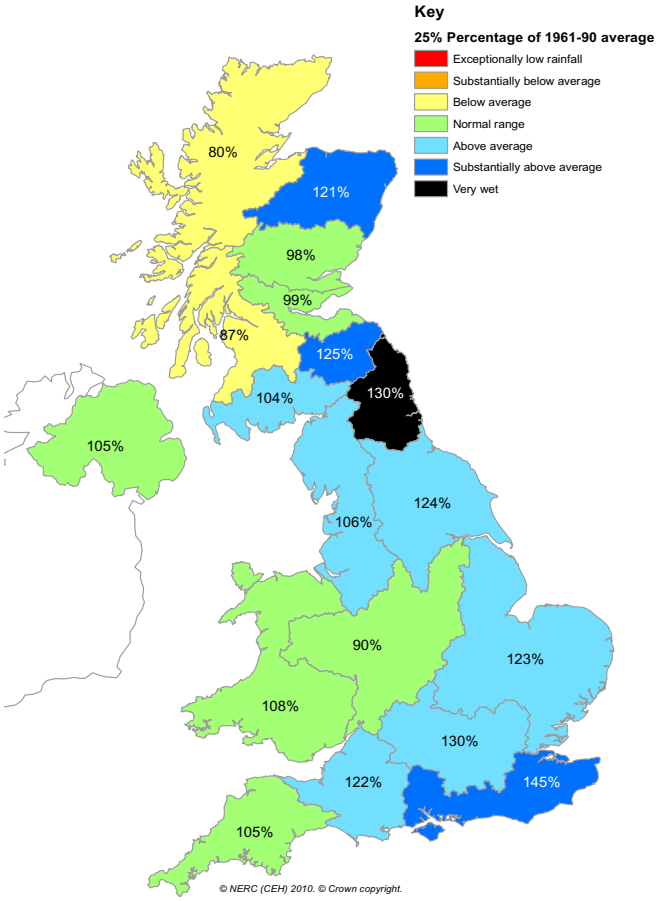

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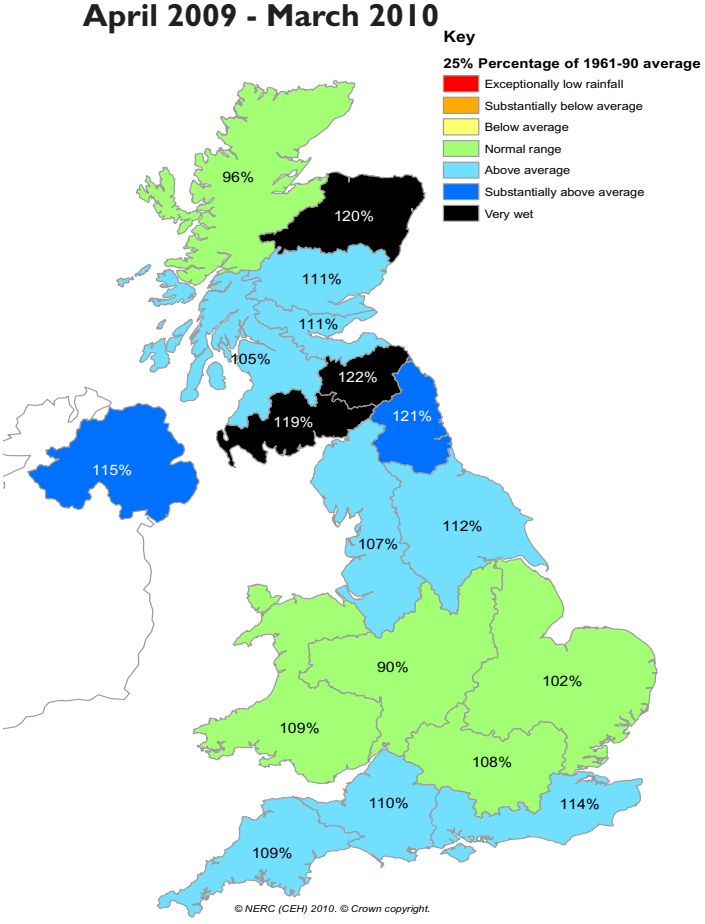


Met Office Weather forecast

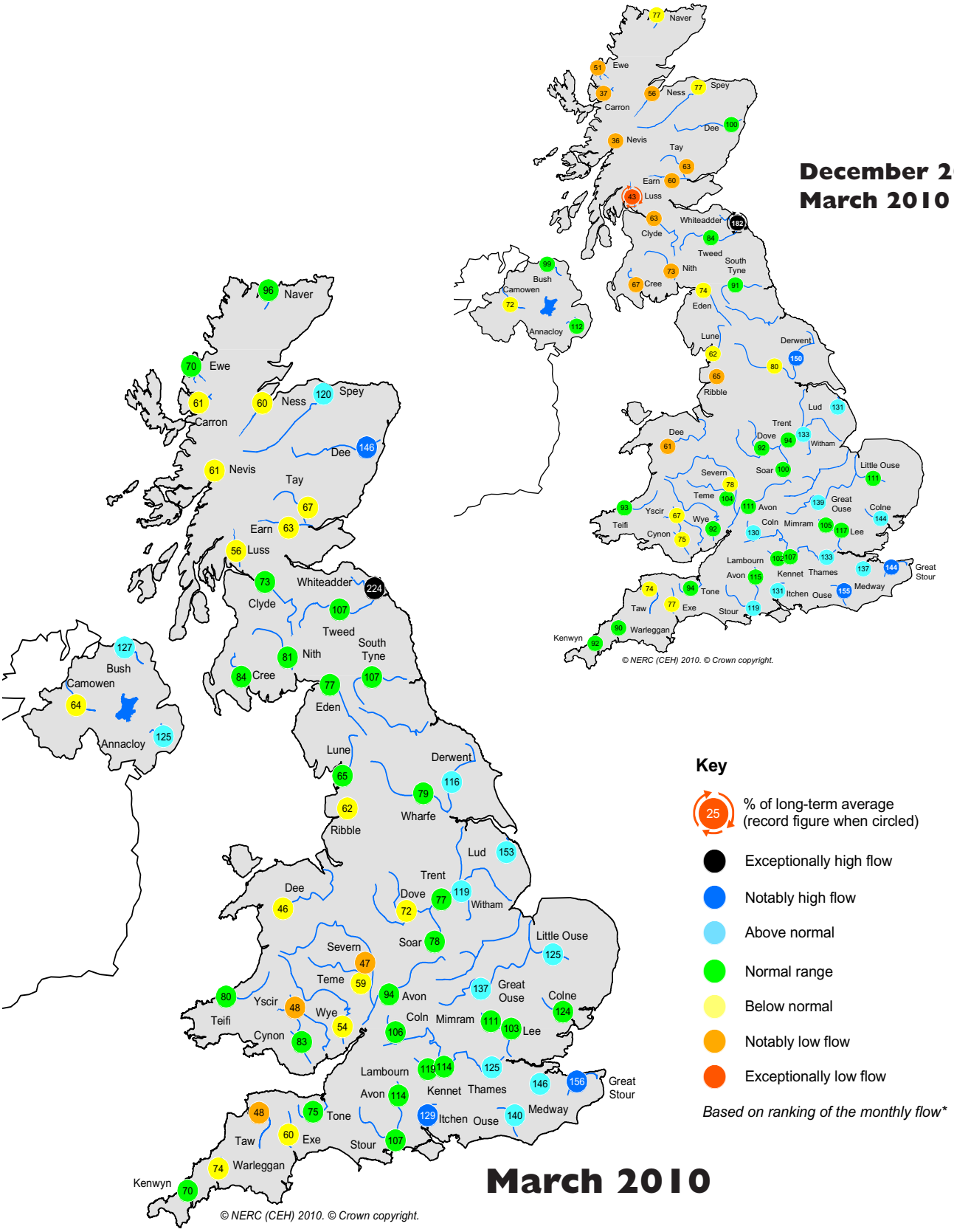
Updated: 1234 on Mon 12 Apr 2010

UK Outlook for Sat 17 Apr 2010 to Mon 26 Apr 2010:
Rain is expected to move southwards across the country on Sunday and Monday after a dry start for the south. This will be followed by showers in northern areas, turning wintry over hills, with snow perhaps falling to low levels in the far north. The unsettled theme is set to continue for most of the week then, with rain or showers for most areas, falling as snow at times on northern hills. Some clearer and sunnier intervals are expected too, however, with southern and eastern areas becoming generally drier towards the weekend. Windy at times in the north with a risk of gales. Temperatures are likely to be rather cold in the north, with a risk of overnight frost, but closer to normal, perhaps warm later, in southern areas.

UK Outlook for Tues 27 Apr 2010 to Tues 11 May 2010:
Staying unsettled for most areas, especially in the north and west, with rain or showers and with the driest weather most likely in southern parts. However, there should be some good spells of sunshine in between the rain or showers, particularly in the south and east. Temperatures in the north are likely to be generally below average for the time of year, cold enough for snow at times over higher ground, but closer to normal, occasionally warm, in the south. Winds often strong on windward coasts. There is a risk of overnight frosts for some more sheltered parts.

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

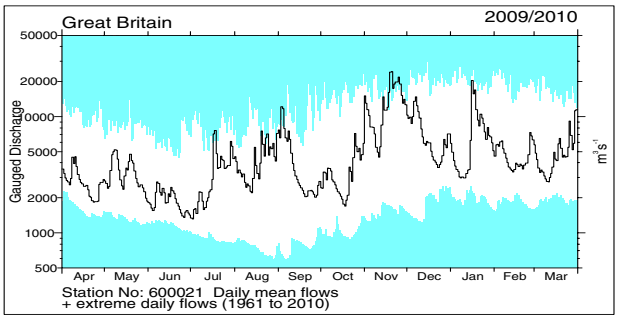
River flow . . . River flow . . .

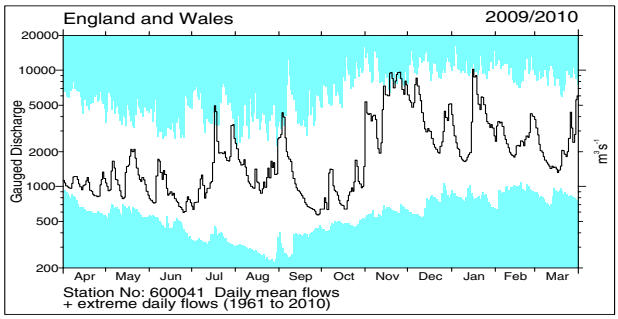


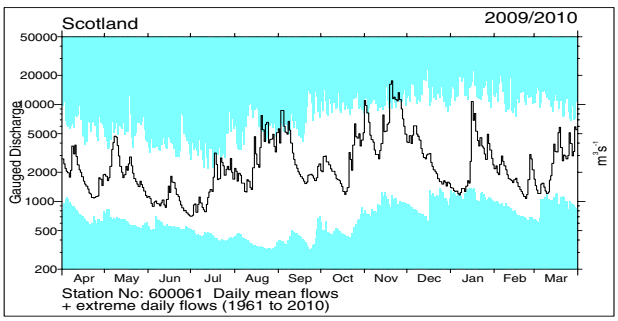
River flows

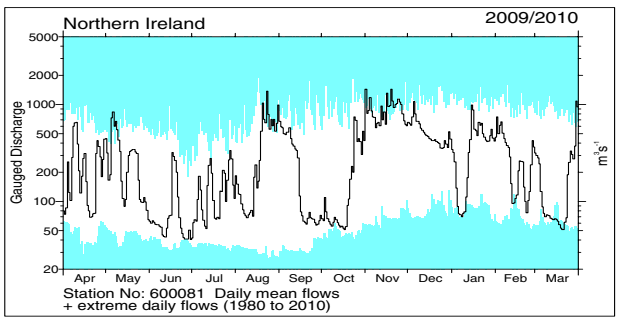
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station. Percentages may be omitted where flows are under review.

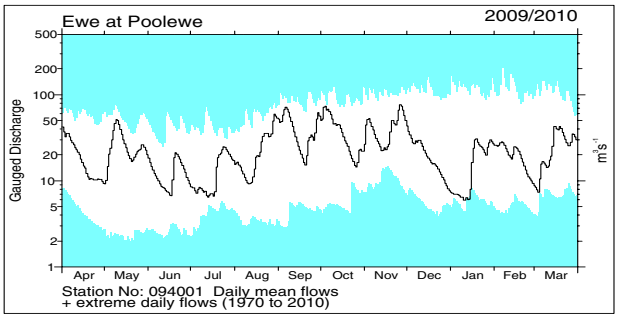
River flow . . . River flow . . .

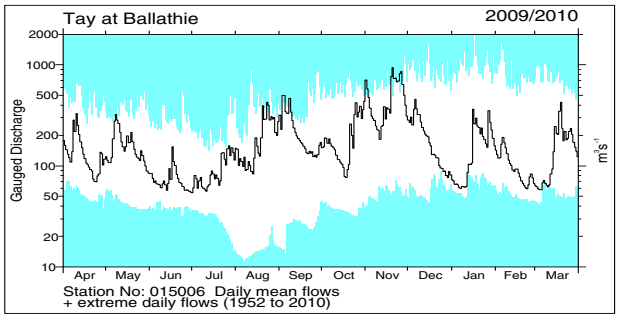


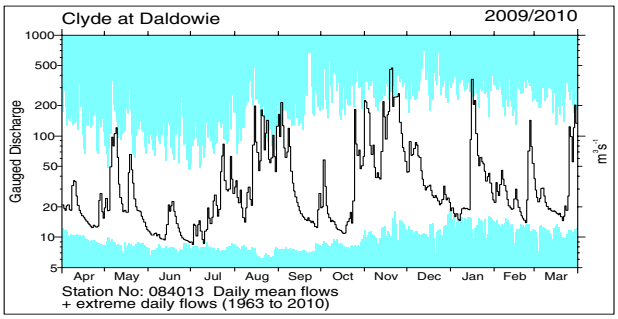


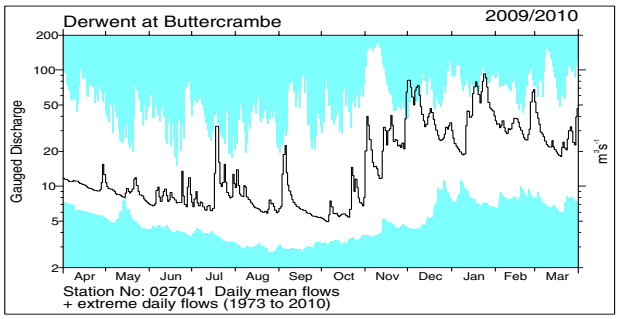


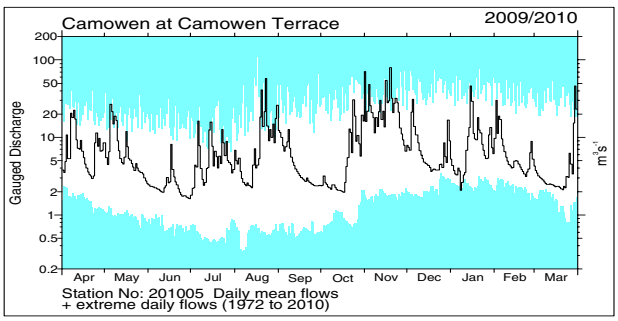


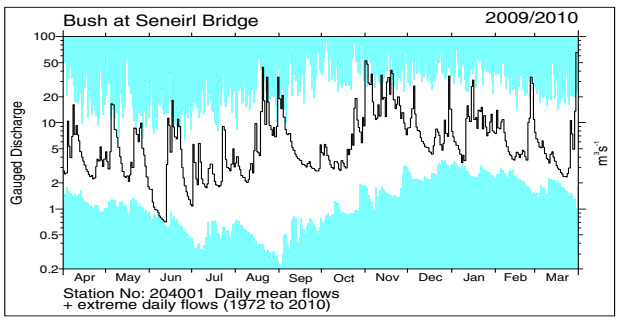








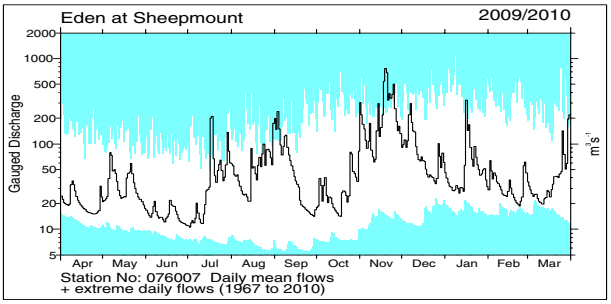


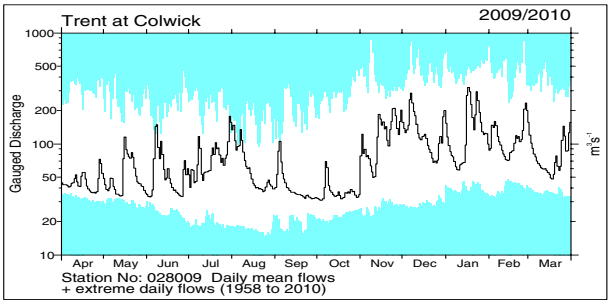


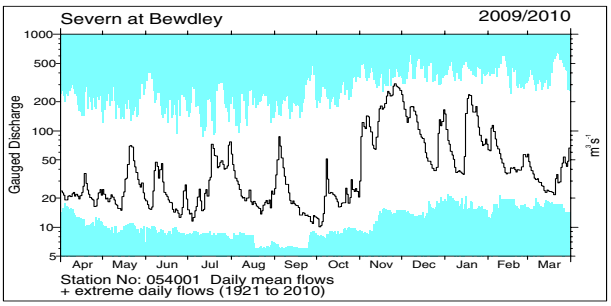
River flow hydrographs

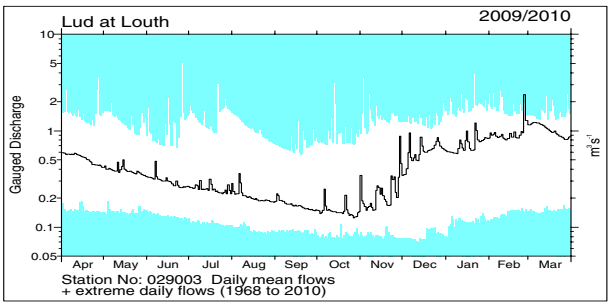
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2009 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

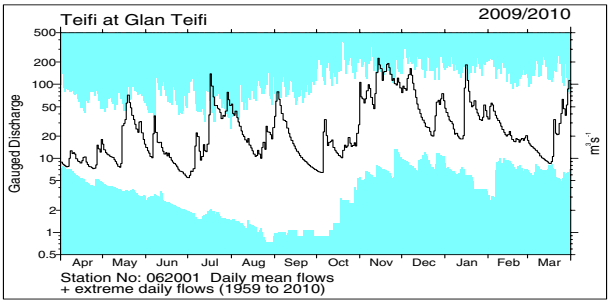
River flow . . . River flow . . .

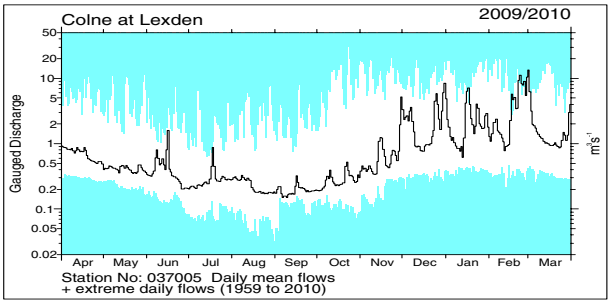


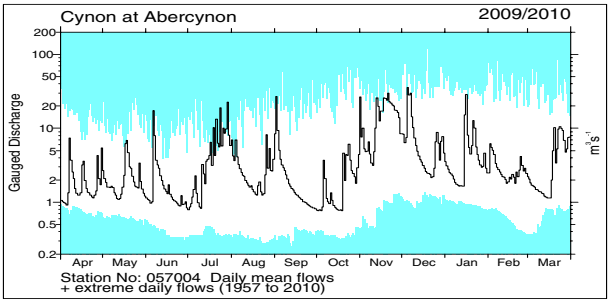


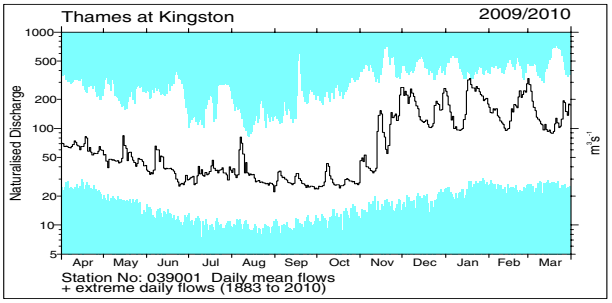


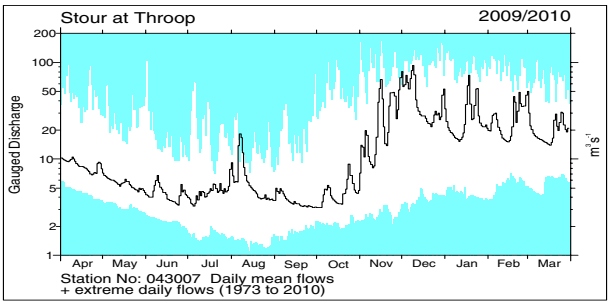


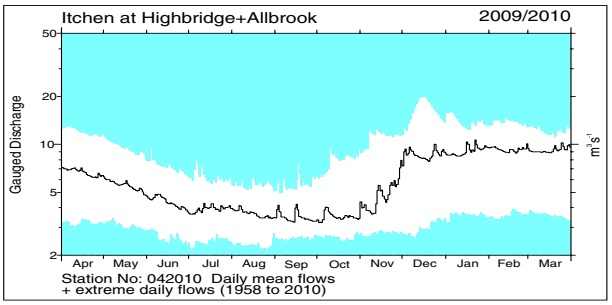












Notable runoff accumulations (a) December - March 2010, (b) April 2009 - March 2010

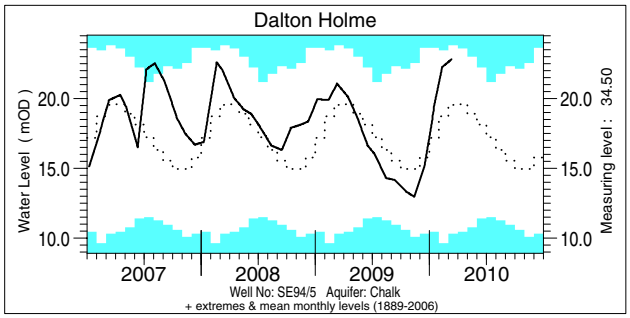
	River	%lta	Rank
a)	Deveron	170	50/50
	Tay	63	3/58
	Forth	44	1/29
	Tyne (Spilmersford)	170	45/45
	Whiteadder	182	41/41
	Blackwater	157	56/58
	Mole	164	34/36
	Ouse (Gold Bridge)	155	46/48

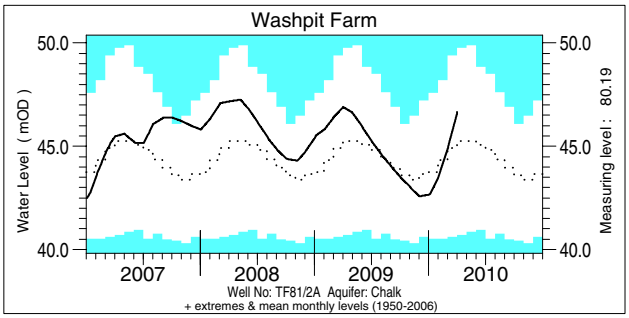
	River	%lta	Rank
a)	Dee (New Inn)	61	3/41
	Luss	43	1/31
	Nevis	36	2/28
	Carron	37	2/31
	Ewe	51	3/40
	Mourne	62	2/28
	Faughan	64	1/34

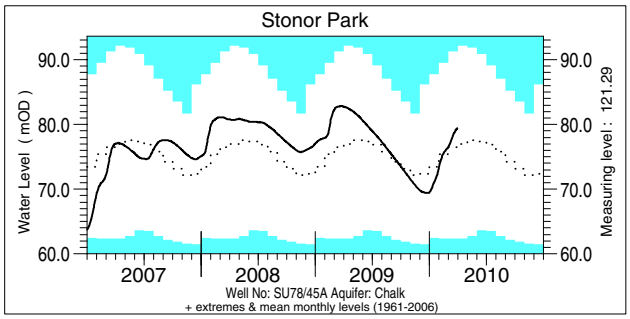
	River	%lta	Rank
b)	Dover Beck	139	30/34
	Nith	124	48/52
	Camowen	122	32/36
	Bush	119	31/35
	Annacloy	130	27/30

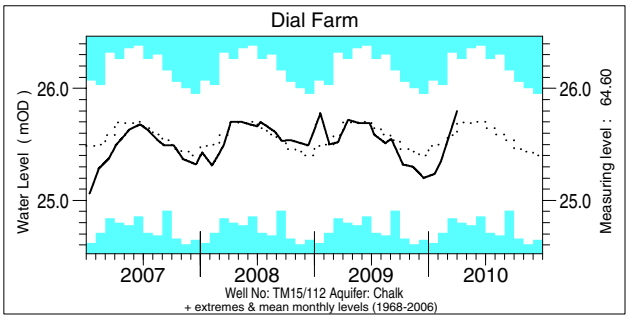
lta = long term average
Rank 1 = lowest on record

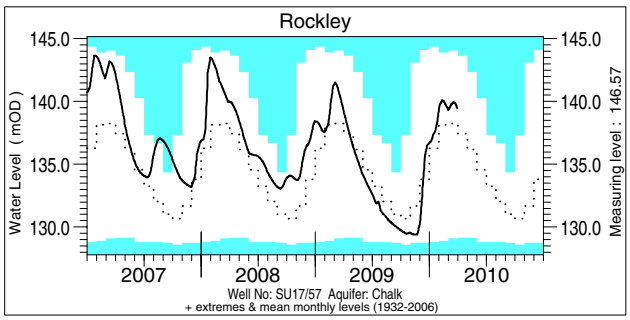
Groundwater . . . Groundwater

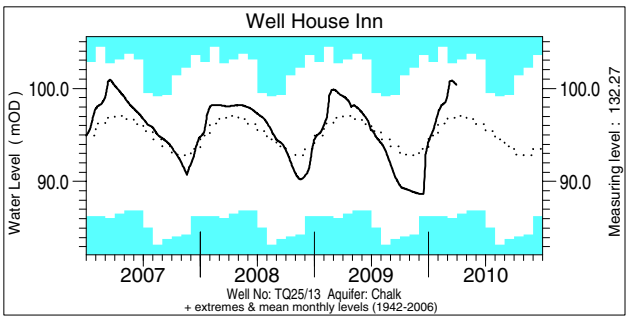


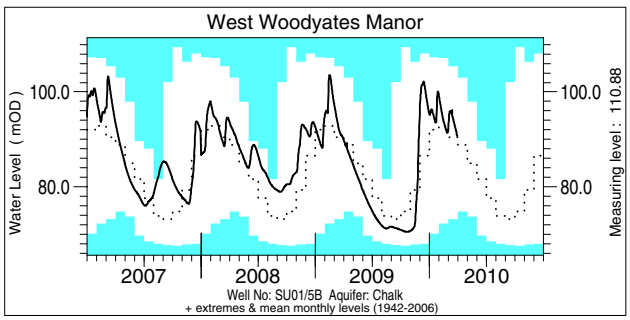


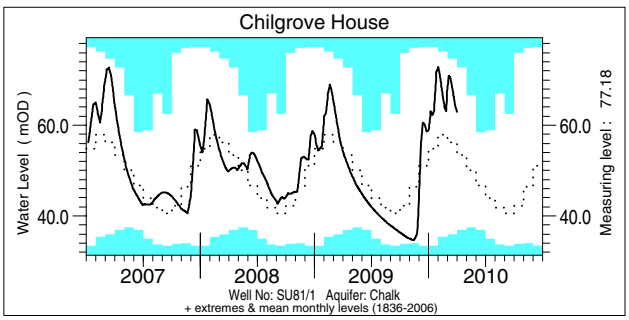


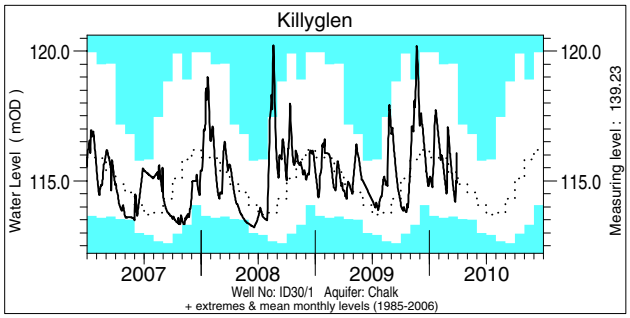


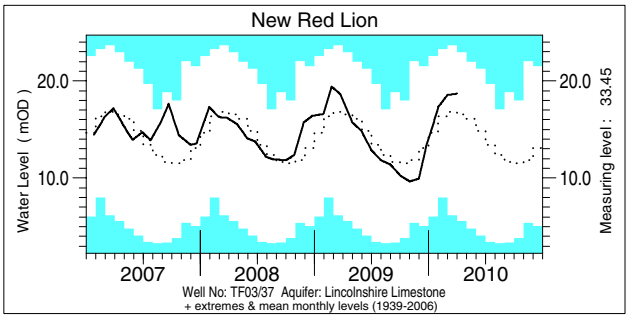






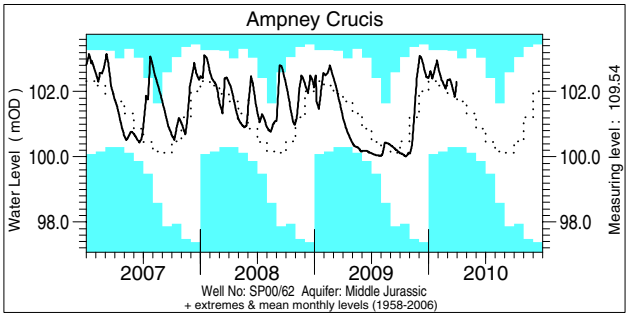


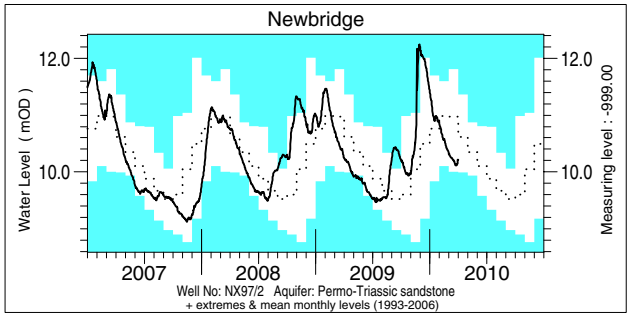


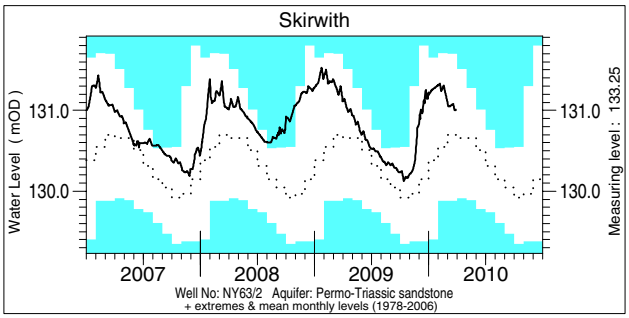


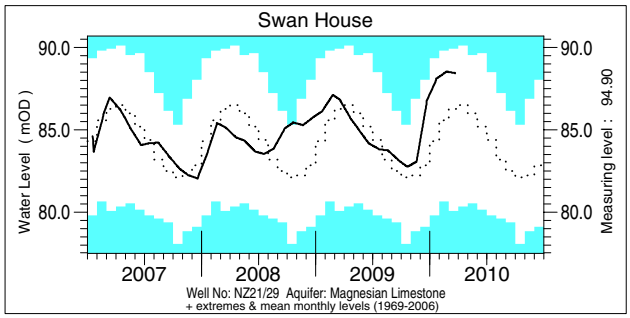
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

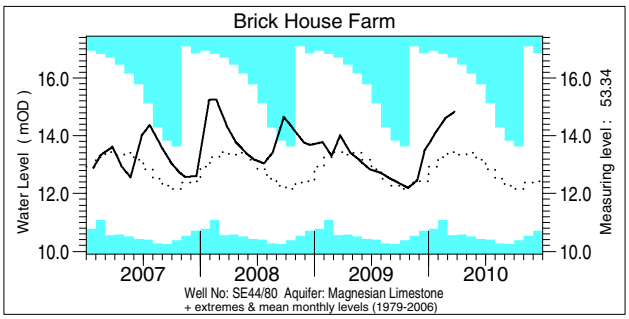
Groundwater . . . Groundwater

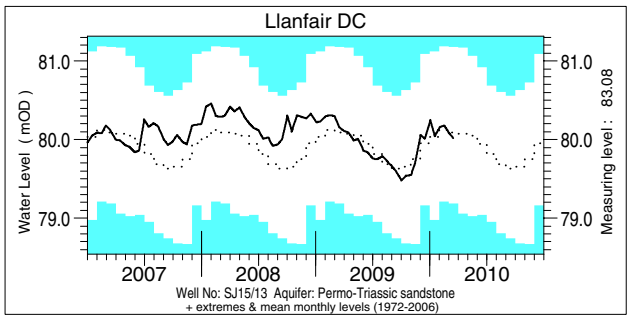


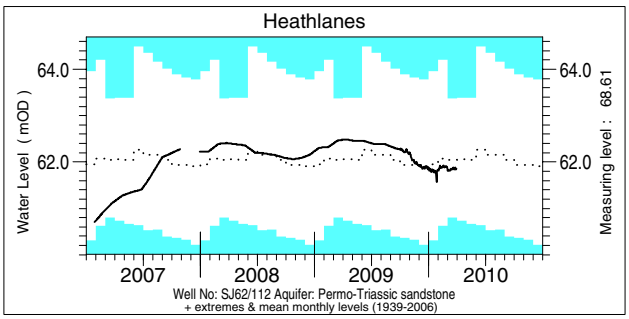


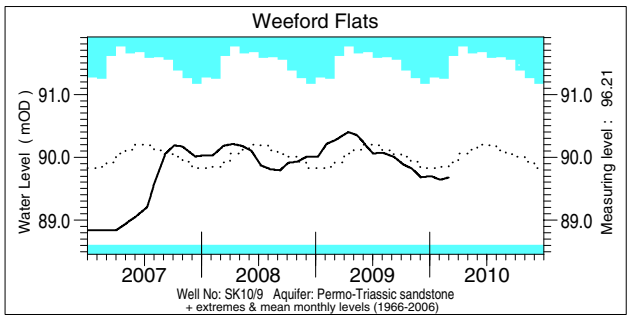


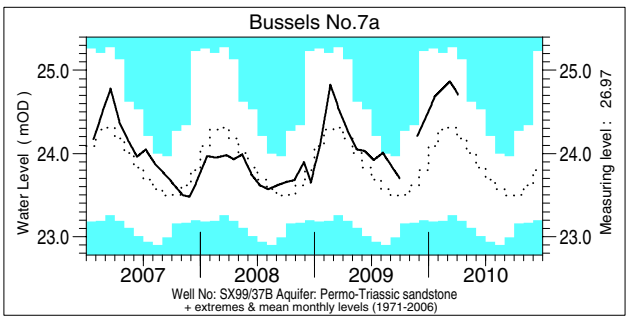


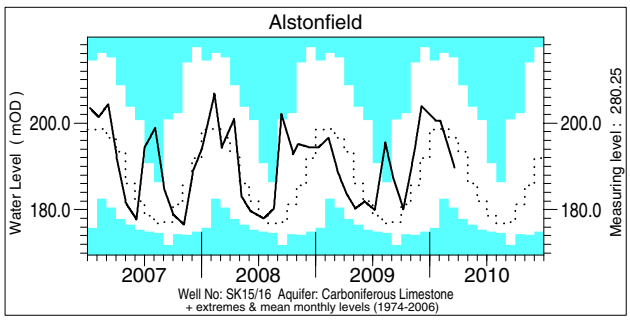












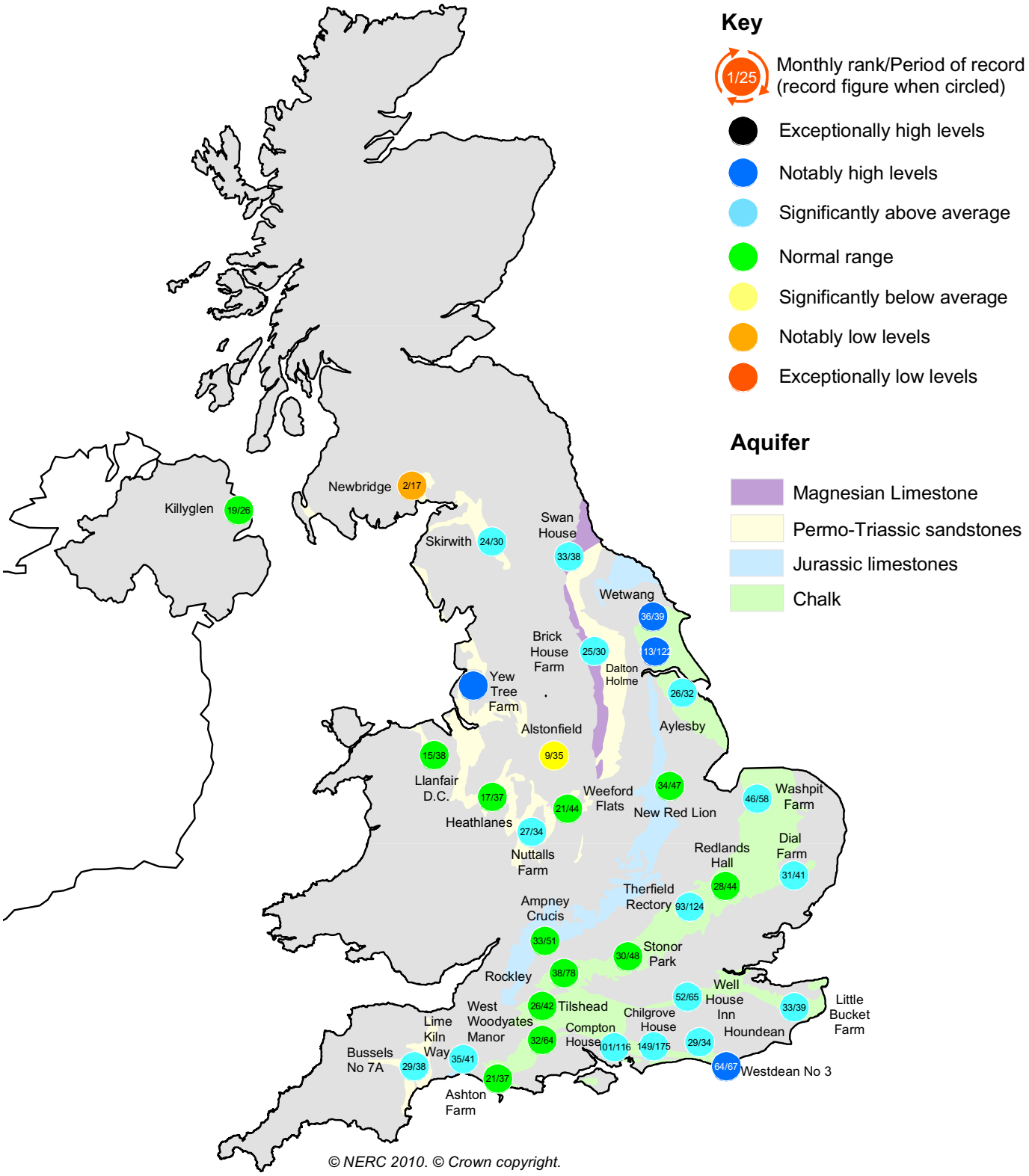
Groundwater levels March / April 2010

Borehole	Level	Date	Mar. av.
Dalton Holme	22.81	11/03	19.49
Washpit Farm	46.67	01/04	45.04
Stonor Park	79.47	31/03	76.80
Dial Farm	25.80	31/03	25.57
Rockley	139.44	31/03	138.47
Well House Inn	100.39	29/03	96.93
West Woodyates	90.75	31/03	90.77

Borehole	Level	Date	Mar. av.
Chilgrove House	62.89	31/03	55.52
Killyglen (NI)	116.08	29/03	115.50
New Red Lion	18.69	31/03	16.66
Ampney Crucis	102.30	31/03	102.00
Newbridge	10.21	31/03	10.85
Skirwith	131.01	29/03	130.71
Swan House	88.43	22/03	85.76

Borehole	Level	Date	Mar. av.
Brick House Farm	14.83	23/03	13.36
Llanfair DC	80.02	15/03	80.07
Heathlanes	61.86	31/03	62.01
Weeford Flats	89.68	02/03	89.77
Bussels No.7a	24.71	04/04	24.32
Alstonfield	189.74	19/03	196.20

Levels in metres above Ordnance Datum



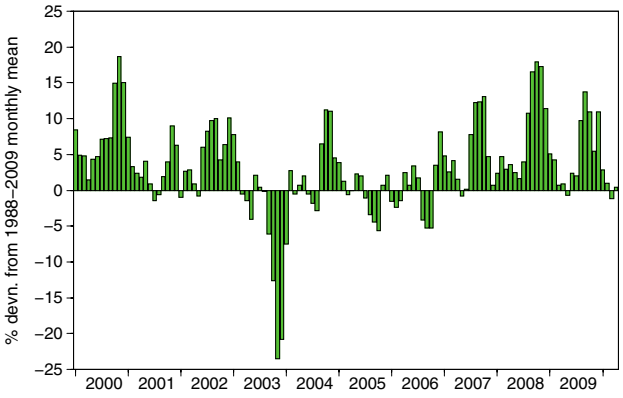
Groundwater levels - March 2010

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.

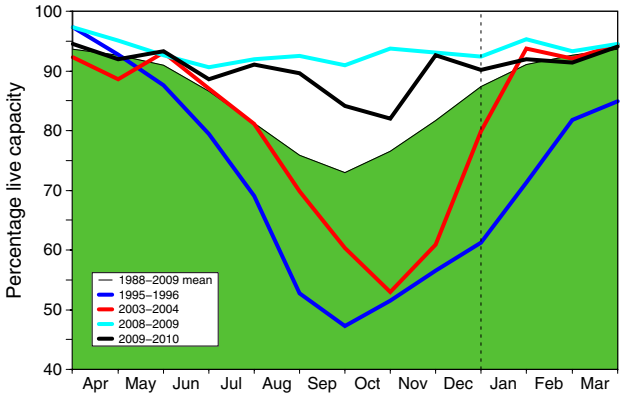
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

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.

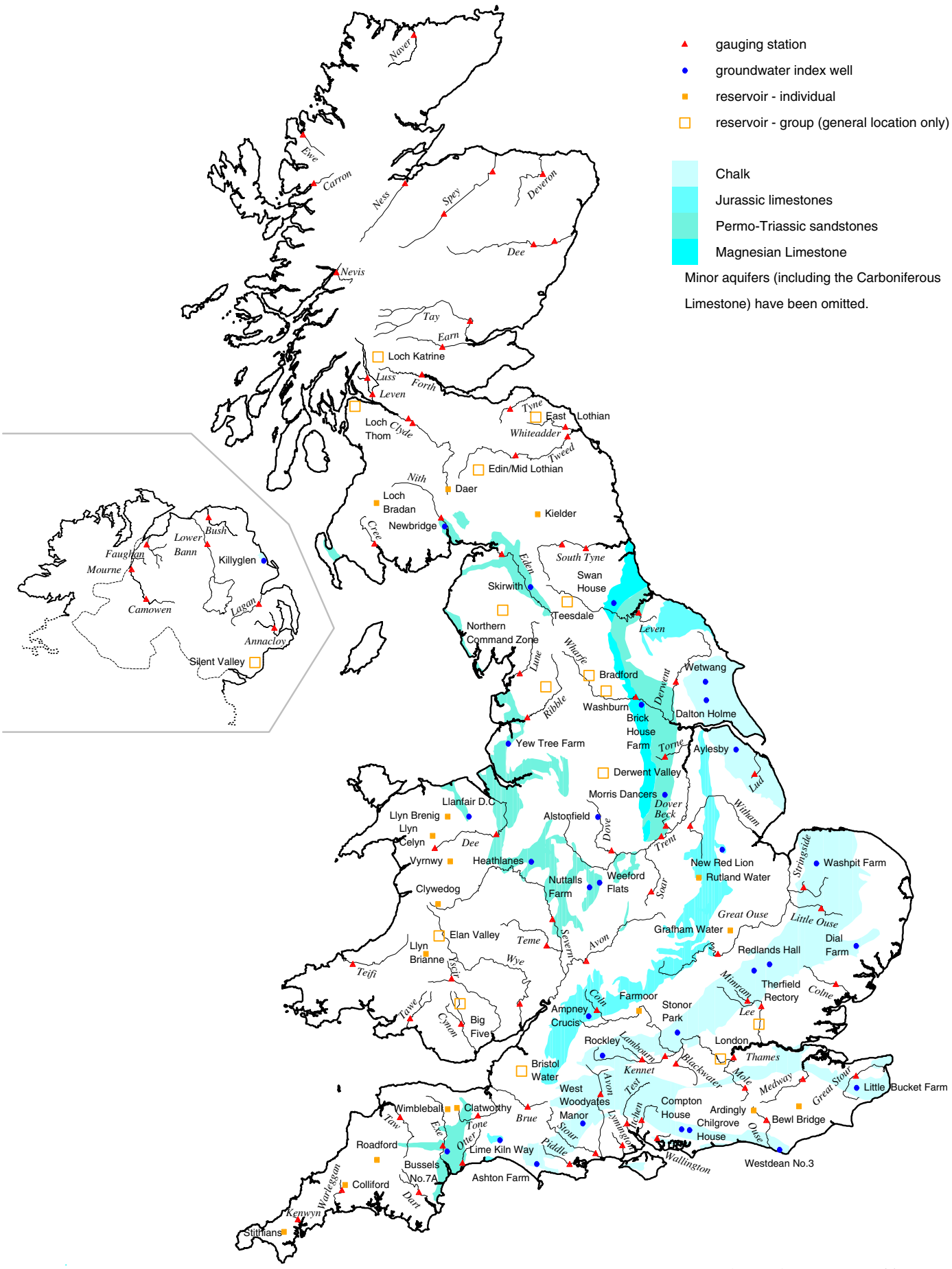
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2010 Feb	Mar	Apr	Apr Anom.	Min Apr	Year* of min	2009 Apr	Diff 10-09
North West	N Command Zone	•	124929	86	80	**82**	-11	77	1993	85	-3
	Vyrnwy		55146	96	93	**92**	-3	64	1996	94	-2
Northumbrian	Teesdale	•	87936	89	82	**96**	3	77	2003	96	0
	Kielder		(199175)	(95)	(90)	**(93)**	1	(81)	1993	(90)	3
Severn Trent	Clywedog		44922	83	87	**92**	-3	86	1996	95	-3
	Derwent Valley	•	39525	100	100	**100**	5	54	1996	95	5
Yorkshire	Washburn	•	22035	96	98	**95**	2	70	1996	93	2
	Bradford supply	•	41407	100	99	**99**	5	59	1996	94	5
Anglian	Grafham		(55490)	(85)	(90)	**(92)**	1	(77)	1997	(95)	-3
	Rutland		(116580)	(82)	(91)	**(94)**	3	(74)	1992	(93)	1
Thames	London	•	202828	92	90	**92**	-2	88	1990	97	-5
	Farmoor	•	13822	73	79	**85**	-10	84	1992	100	-15
Southern	Bewl		28170	97	100	**100**	10	58	1989	92	8
	Ardingly		4685	100	100	**100**	1	88	2006	100	0
Wessex	Clatworthy		5364	100	95	**100**	3	82	1992	98	2
	Bristol WW	•	(38666)	(95)	(100)	**(96)**	3	(71)	1992	(97)	-1
South West	Colliford		28540	100	99	**99**	13	58	1997	100	-1
	Roadford		34500	94	94	**92**	7	37	1996	95	-3
	Wimbleball		21320	100	100	**99**	3	78	1996	100	-1
	Stithians		4967	100	99	**100**	7	52	1992	96	4
Welsh	Celyn and Brenig	•	131155	96	99	**100**	2	72	1996	100	0
	Brianne		62140	98	96	**99**	1	90	1993	97	2
	Big Five	•	69762	88	92	**98**	2	78	1993	95	3
	Elan Valley	•	99106	100	97	**95**	-3	89	1993	98	-3
Scotland(E)	Edinburgh/Mid Lothian	•	97639	100	98	**94**	-1	71	1998	100	-6
	East Lothian	•	10206	100	100	**100**	1	95	1990	99	1
Scotland(W)	Loch Katrine	•	111363	86	76	**74**	-20	**74**	**2010**	98	-24
	Daer		22412	99	95	**94**	-4	93	2001	99	-5
	Loch Thom	•	11840	95	95	**83**	-15	**83**	**2010**	96	-13
Northern Ireland	Total+	•	56920	98	94	**99**	11	83	2002	87	12
	Silent Valley	•	20634	96	91	**100**	16	57	2000	82	18

() 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

04/10