Hydrological Summary
for the United Kingdom

December 2011

General
Meteorologically, 2011 was a remarkable year: it was the second warmest in the UK temperature record (from 1910) and was notable for extreme regional disparities in rainfall receipt – with continuing drought conditions in the English Lowlands contrasting dramatically with Scotland, which had its wettest year on record. The year ended on a stormy note, with high winds and heavy rainfall, but the brunt of the storms was borne by upland areas. In the English Lowlands, the frontal systems had limited impact, yielding average December rainfall which, whilst welcome following the dry autumn, was not sufficient to significantly relieve drought stress. Similarly, widespread and common flood alerts in northern Britain contrasted with seasonally depressed flows in the English Lowlands. Stocks increased in most UK reservoirs (and are healthy in a majority of gravity-fed impoundments), with particularly useful increases in the southwest, but they remain below average across much of southern England. Levels are particularly depressed at Bewl and Ardingly – a drought order was granted to enable levels to be maintained in the latter. Entering 2012, the focus of the drought has shifted to groundwater resources. Whilst muted recoveries were initiated in parts of the southern Chalk and more responsive aquifers, groundwater levels remain notably low across the Chalk and parts of the West Midlands, with exceptionally dry soils (for the time of year) continuing to inhibit infiltration in eastern areas. Substantially above average rainfall is needed over the next 10 - 12 weeks to improve the water resources outlook for the rest of 2012.

Rainfall
December saw an almost continuous westerly airflow, with a relentless sequence of depressions passing over the British Isles, bringing unsettled weather to most localities. In northern and western Britain, in particular, it was extremely windy and wet, with storms bringing disruption to many areas. Orographic enhancement contributed to significant rainfall totals, particularly in the Scottish Highlands (e.g. 64mm at Loch Glascarnoch on the 8th; 89mm at Kinlochewe on the 26th), where significant amounts fell as snow (with substantial accumulations reported on the 5th, e.g. 15cm at Eskdalemuir) – although snow penetrated as far south as the Chilterns on the 16th. December rainfall for the UK was significantly above average, but this reflects a disproportionate contribution from upland areas – Scotland as a whole received 160% of its average December rainfall, with well over twice the monthly average reported in parts of the Highlands – whilst rainfall in most of lowland England was in the normal range. However, substantial deficiencies can be noted over the longer term, in particular in Anglian (which has seen the greatest deficit in the latter months, experiencing its third driest Sep-Dec on record) and Midlands (which registered its driest Mar-Dec on record). The northwest/southeast gradient is reflected in figures for the year as a whole: 2011 was the wettest year (by a considerable margin) in the record from 1910 for Scotland, whilst Midlands and Anglian regions had their second driest years since 1921.

River Flows
Spates were a common occurrence throughout the month across northern and western Britain, leading to widespread and regular flood warnings, some of which were due to exceptional snowmelt rates (e.g. on the 26th in Scotland). Flooding was localised (e.g. on the 8th in Cumbria and North Yorkshire and on the 23rd in South Wales) and disruption was generally limited in comparison with that caused by dangerous winds. Despite the prevalence of spates, high river flows were notable more for their persistence rather than magnitude, although the Faughan (Northern Ireland) registered its highest December flow in a record from 1976, and the South Tyne (NE England) and the Leven (SW Scotland) had their second highest December flows in records from the early 1960s. A distinct partitioning can be noted in the month's runoff totals, with appreciably above average runoff in northern and western catchments contrasting with notably low runoff across much of the lowlands (particularly in groundwater-fed catchments such as the Coln, Lambourn and Little Ouse; the latter registered its lowest December flow on record). This broadly reflects runoff patterns for 2011 as a whole: new maximum annual runoff totals were registered in catchments in Scotland and Northern Ireland, while several Midlands catchments (e.g. the Soar and Teme) and the Kenwyn (Cornwall) yielded their lowest annual runoff. Provisional figures suggest the 2011 runoff total for Scotland was the highest on record (from 1961), exceeding the second highest (for 2008) by a significant margin. Conversely, runoff for the English lowlands was comparable with 1973 and 1997; only in 1976 was runoff lower.

Groundwater
The rainfall received across lowland Britain resulted in a decrease in soil moisture deficits (smds) in most aquifer areas, with smds all-but eliminated this month along the south coast. However, in the central and eastern districts under the most drought stress, smds are still exceptional for the time of year (particularly in parts of East Anglia around the Wash where December rainfall was below average). End-of-month smds for Anglian region were the highest on record, whilst for the English Lowlands as a whole they were the second highest (after 1964). Groundwater levels reflect these spatial contrasts: moderate increases were observed in some boreholes in the southern Chalk (e.g. Chilgrove, West Woodyates and Ashton Farm) whereas recessions continued in boreholes in the Thames Valley and East Anglia. Thus, despite moderate, localised improvements, recharge was generally limited and the groundwater resources situation in the Chalk remains fragile. Based on an index aggregated from seven widely-distributed index boreholes, total groundwater storage in the Chalk was the fourth lowest for December (in a 62-year series) – only during the sustained droughts of the 1970s and 1990s was storage lower at the equivalent time. In other aquifers, diminishing smds prompted steep recoveries in more responsive limestone boreholes (e.g. Alstonfield in the Carboniferous limestone and Ampney Crucis in the Jurassic limestone of the Cotswolds), but in the slowly- responding Permo-Triassic of the Midlands, a focal area of the drought, recessions continue to develop in response to long-term recharge deficiencies.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

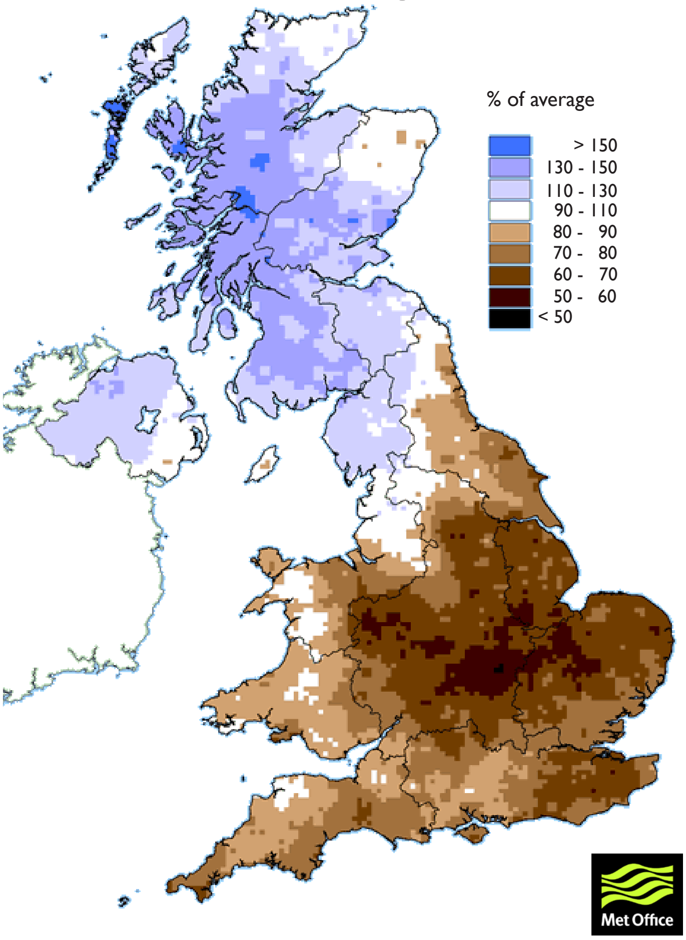
Area	Rainfall	Dec 2011	Sep11 - Dec11	RP	Mar11 - Dec11	RP	Jan11 - Dec11	RP	Dec09 - Dec11	RP
United Kingdom	mm	**168**	498		953		1170		2222	
	%	**140**	112	5-10	108	2-5	108	2-5	97	2-5
England	mm	**103**	268		555		711		1532	
	%	**116**	83	2-5	82	10-20	87	8-12	89	12-16
Scotland	mm	**265**	842		1582		1886		3244	
	%	**164**	139	>100	137	>100	131	>100	107	5-10
Wales	mm	**218**	557		1001		1280		2562	
	%	**132**	96	2-5	90	5-10	93	2-5	88	10-15
Northern Ireland	mm	**154**	613		1057		1260		2385	
	%	**130**	140	>100	117	12-16	113	10-15	102	2-5
England & Wales	mm	**119**	308		616		790		1674	
	%	**120**	86	2-5	84	10-15	88	5-10	89	12-16
North West	mm	**204**	560		1068		1346		2446	
	%	**155**	115	2-5	110	2-5	114	5-10	98	2-5
Northumbria	mm	**96**	295		703		876		1846	
	%	**111**	94	2-5	102	2-5	105	2-5	106	2-5
Midlands	mm	**90**	218		439		558		1265	
	%	**112**	75	5-10	70	80-120	74	50-70	79	80-120
Yorkshire	mm	**102**	272		563		724		1552	
	%	**115**	87	2-5	83	8-12	89	5-10	90	8-12
Anglian	mm	**56**	135		336		436		1097	
	%	**99**	60	30-50	66	60-90	72	30-50	87	10-15
Thames	mm	**76**	184		426		558		1255	
	%	**105**	67	8-12	73	20-30	80	10-20	85	10-20
Southern	mm	**102**	228		476		640		1503	
	%	**116**	69	5-10	74	20-30	82	10-15	91	5-10
Wessex	mm	**103**	276		572		734		1524	
	%	**102**	78	5-10	81	10-15	85	5-10	83	30-40
South West	mm	**172**	453		788		1022		2146	
	%	**115**	89	2-5	82	8-12	85	5-10	84	20-35
Welsh	mm	**205**	531		957		1220		2463	
	%	**130**	95	2-5	89	5-10	92	2-5	88	12-16
Highland	mm	**365**	1055		1911		2241		3700	
	%	**184**	143	>100	140	>100	131	>100	102	2-5
North East	mm	**121**	379		951		1113		2354	
	%	**132**	100	2-5	121	5-10	117	5-10	118	8-12
Tay	mm	**183**	680		1406		1700		2979	
	%	**130**	131	10-20	140	>100	134	>100	111	5-10
Forth	mm	**166**	586		1233		1513		2676	
	%	**134**	127	15-25	135	>100	134	>100	112	10-15
Tweed	mm	**122**	448		1013		1246		2335	
	%	**118**	120	5-10	129	15-25	131	30-40	116	8-12
Solway	mm	**232**	831		1534		1888		3265	
	%	**144**	141	50-80	135	80-120	134	>100	110	8-12
Clyde	mm	**352**	1161		1997		2388		3909	
	%	**179**	158	>100	144	>100	138	>100	107	5-10

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

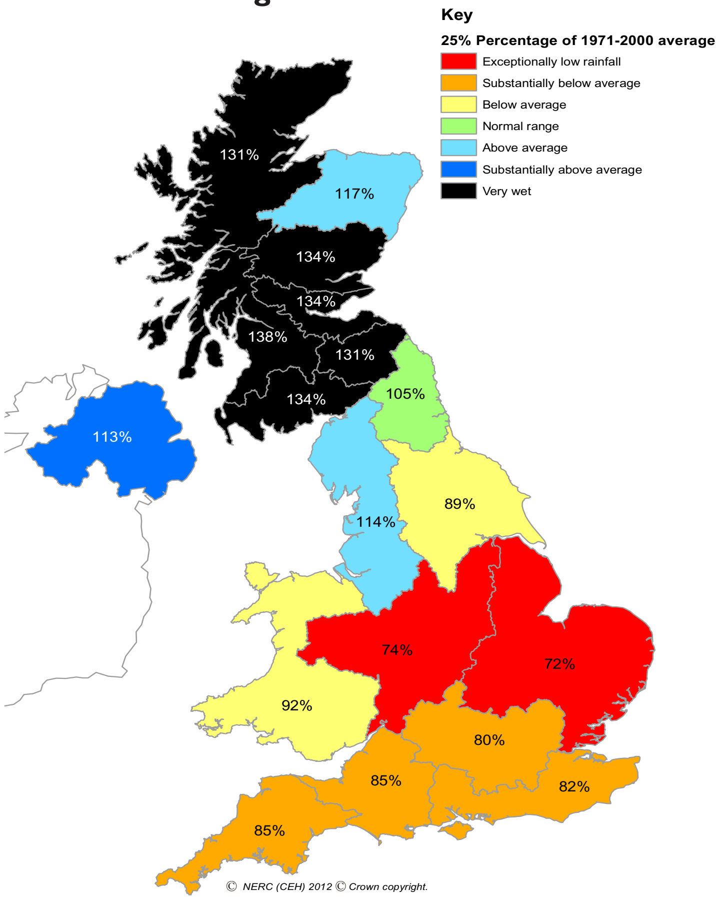
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. All monthly rainfall totals since August 2011 are provisional.

Rainfall . . . Rainfall . . .

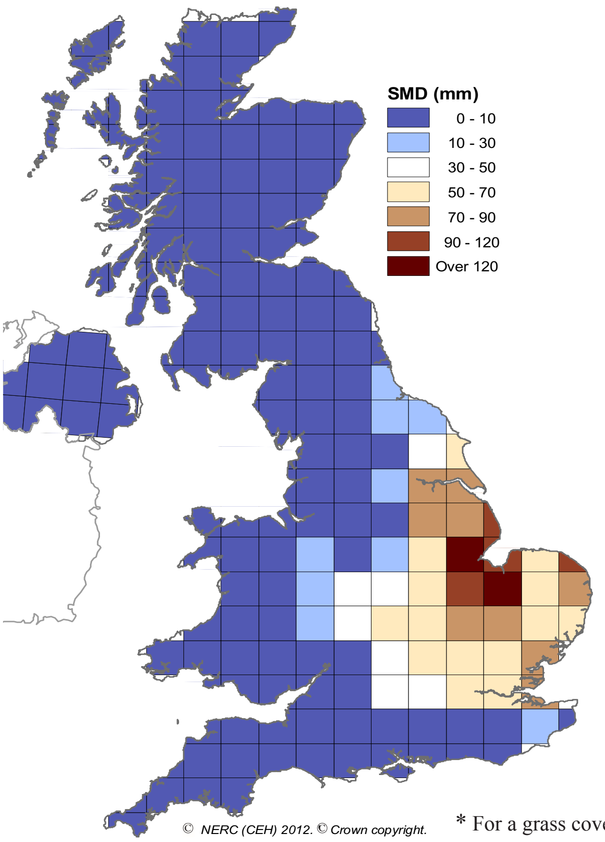
March - December 2011 rainfall as % of 1971-2000 average



January - December 2011 rainfall as % of 1971-2000 average



Soil Moisture Deficits* December 2011



* For a grass cover

Met Office 3-month outlook

For the 3-month period January-March 2012, for UK precipitation, the broad-scale signal, although weak, is for somewhat wetter conditions than normal.

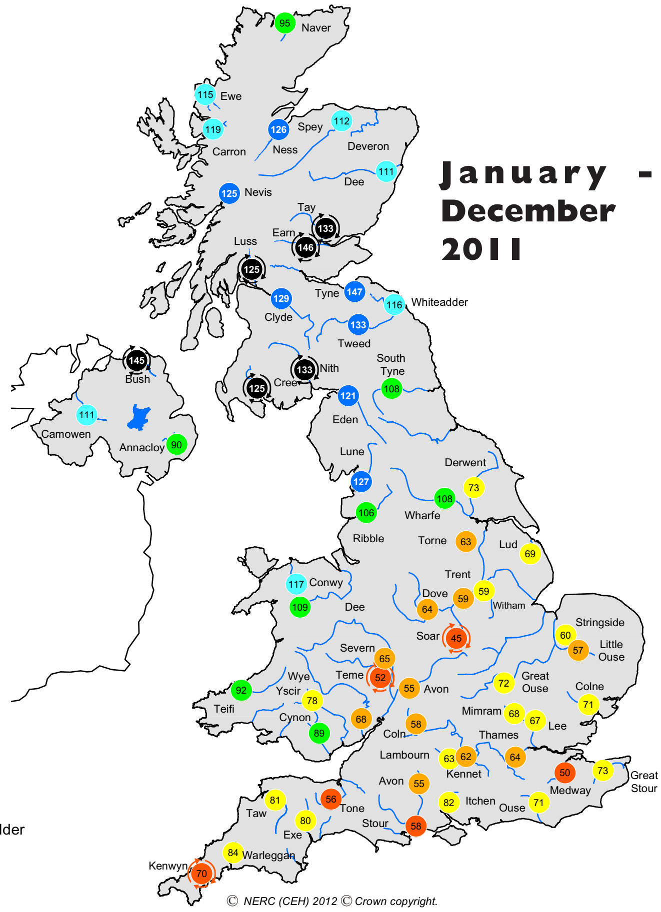
Northwestern parts of the UK are most vulnerable to very wet conditions. Above average winter rainfall is needed in southern, eastern and central England for a full recovery of the water resource situation here - it currently looks unlikely that this will happen.

The probability that UK precipitation for January-March will fall into the driest of our five categories is 15-20%, whilst the probability that it will fall into the wettest of our five categories is 20-25%; each of these categories has occurred in 20% of the years between 1971-2000.

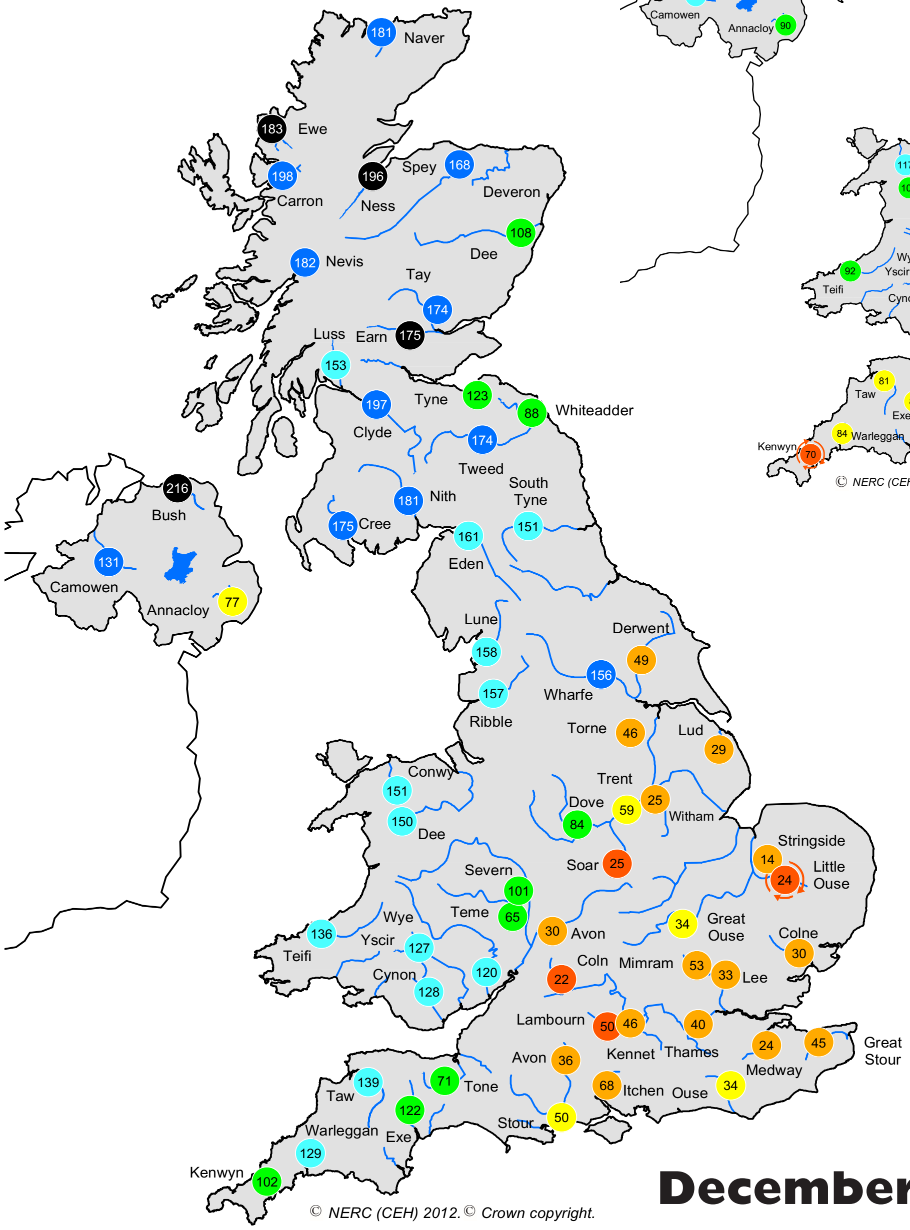
The complete version of the 3-month outlook may be found at:
http://www.metoffice.gov.uk/publicsector/contingency-planners
This outlook is updated towards the end of each calendar month.

The latest shorter-range forecasts, covering the upcoming 30 days, can be accessed via:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_weather.html
These forecasts are updated very frequently.

River flow . . . River flow . . .



January - December 2011



Key

25 % of long-term average (record figure when circled)

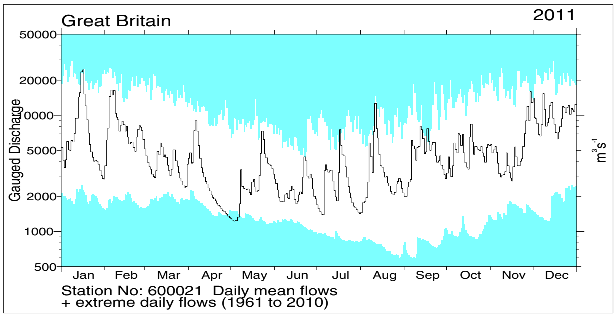
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

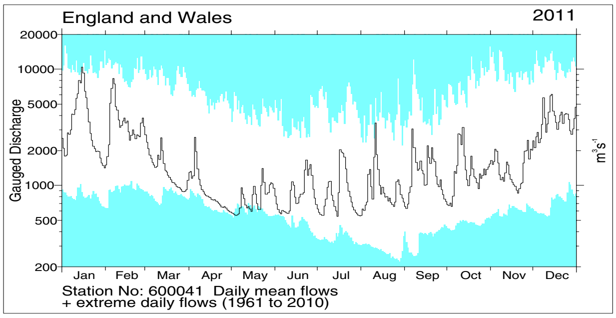
*Based on ranking of the monthly flow**

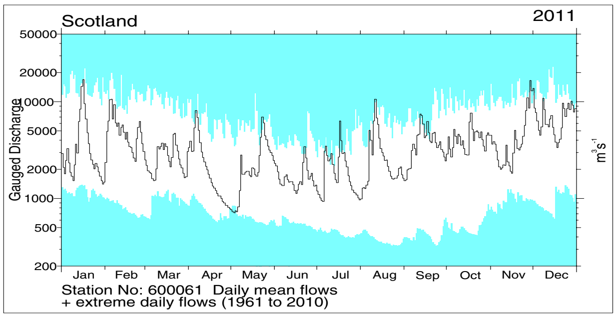
December 2011

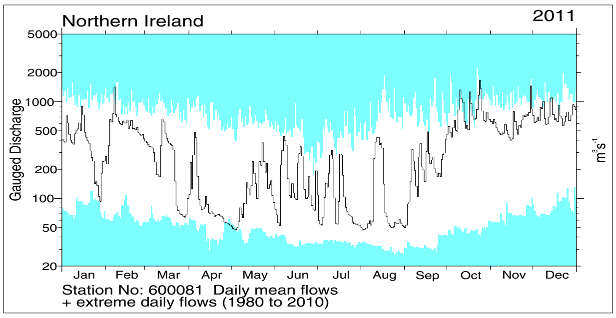
River flows

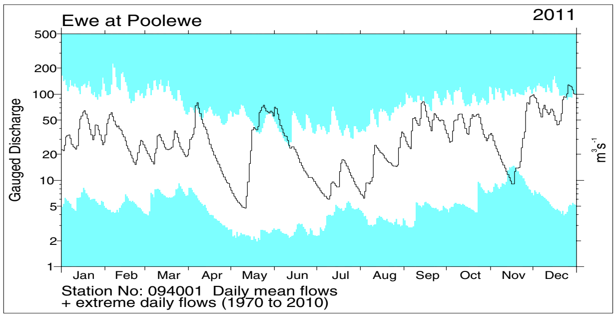
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

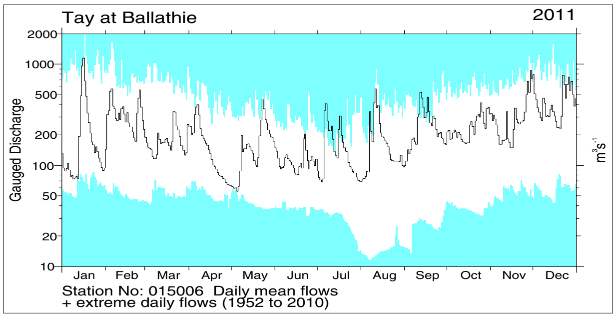


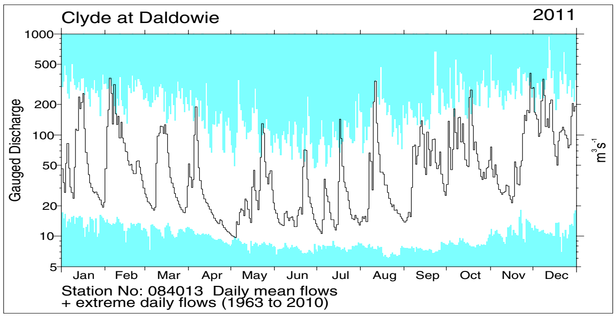


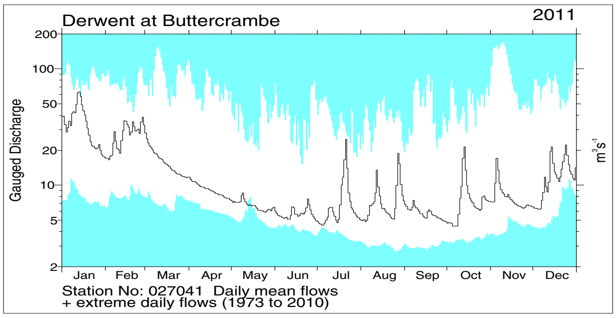


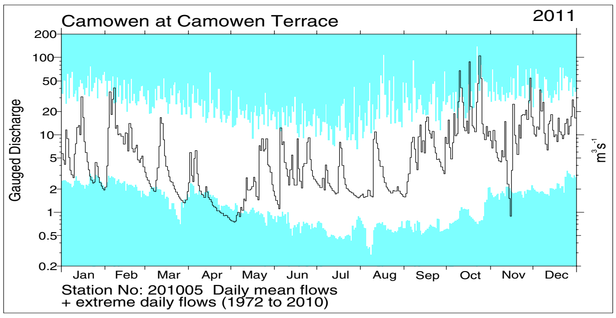


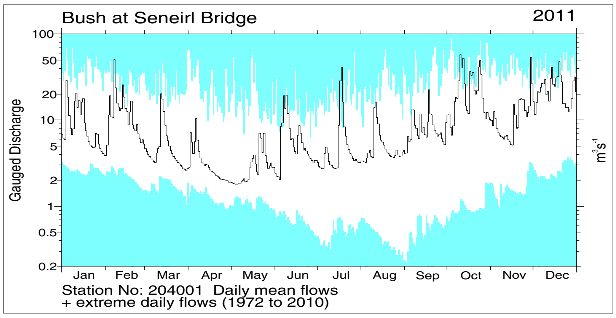








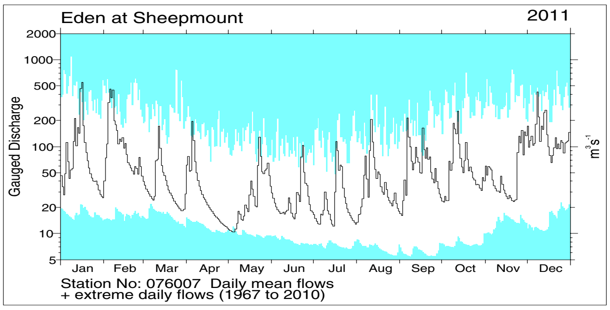


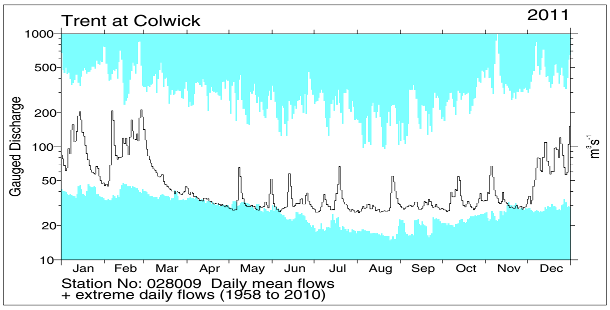


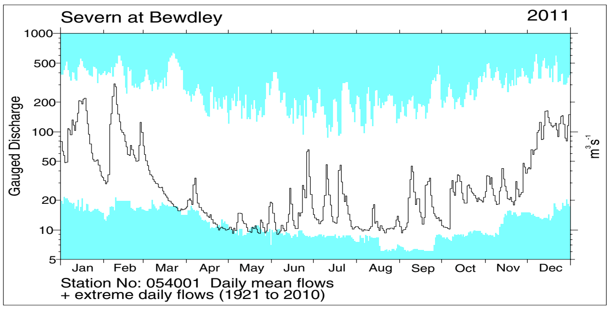
River flow hydrographs

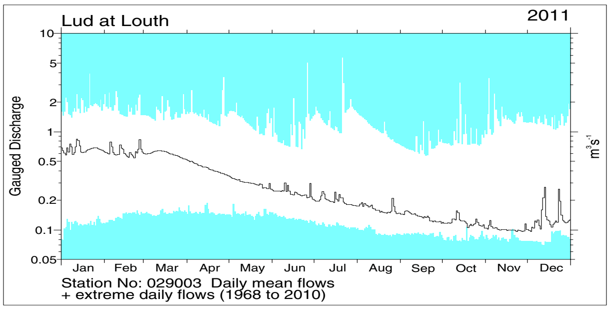
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to January 2011 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

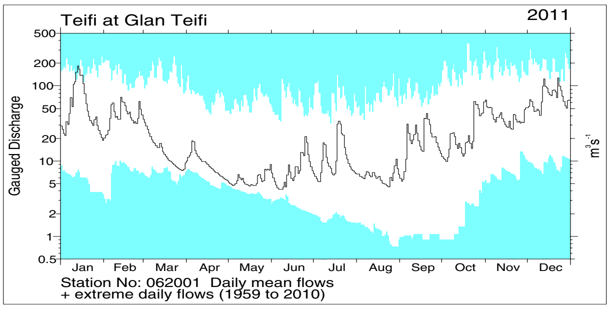
River flow . . . River flow . . .

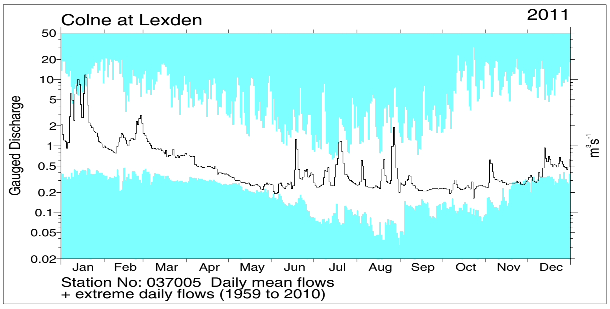


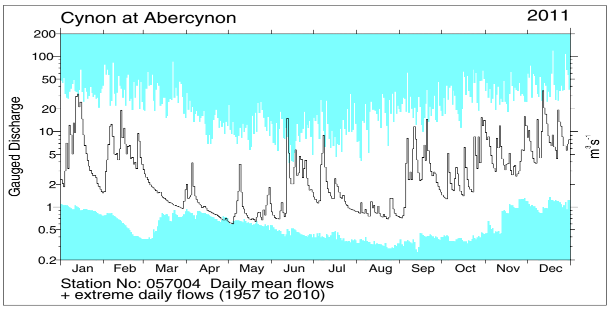


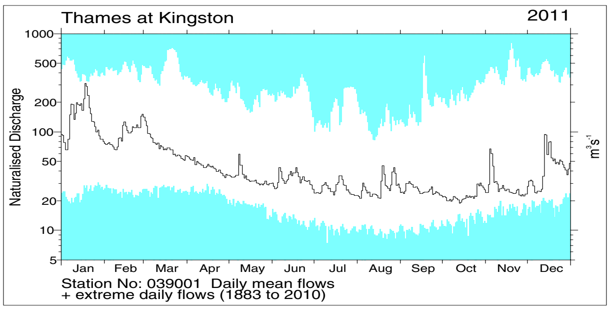


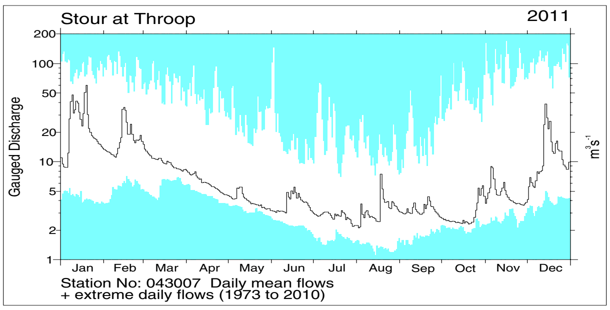


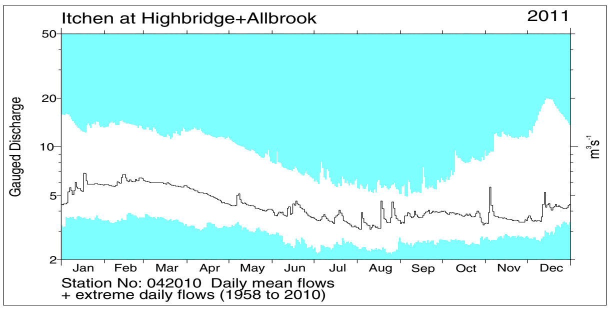












Notable runoff accumulations (a) September - December 2011, (b) April - December 2011

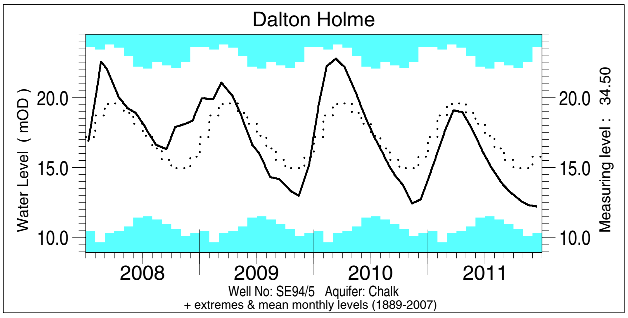
	River	%lta	Rank
a)	Earn	175	64/64
	Forth	166	31/31
	Soar	27	1/41
	Little Ouse	30	1/42
	Kennet	52	1/50
	Lambourn	60	1/49
	Coln	32	1/48
	Medway	22	1/50
	Great Stour	45	1/47
	Avon (Amesbury)	42	1/46

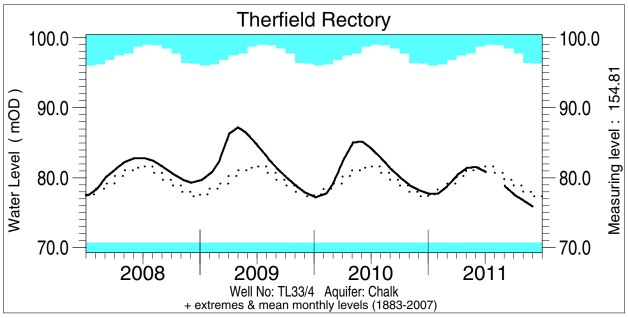
	River	%lta	Rank
a)	Nith	164	54/54
	Clyde (Blairston)	167	52/52
	Nevis	159	29/29
	Carron	143	33/33
	Camowen	168	39/39
	Mourne	175	30/30
	Faughan	161	36/36
	Bush	183	38/38

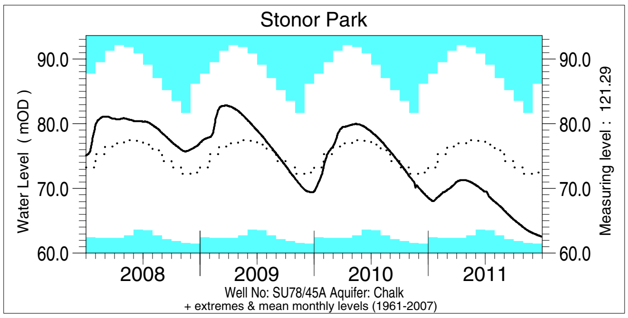
	River	%lta	Rank
b)	Ness	155	39/39
	Tay	151	59/59
	Trent	53	1/53
	Torne	53	1/40
	Cree	140	48/48
	Leven	165	47/47
	Luss Water	140	33/33

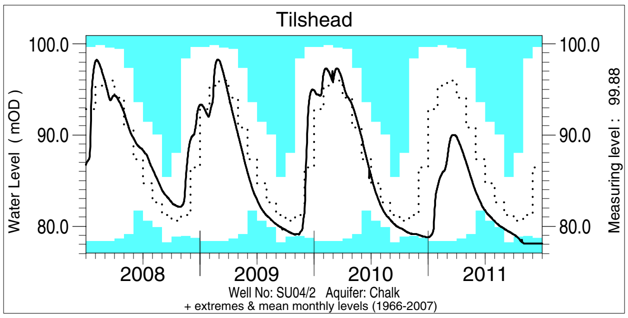
lta = long term average
Rank 1 = lowest on record

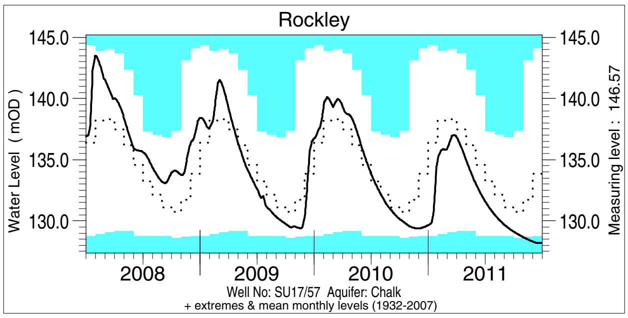
Groundwater . . . Groundwater

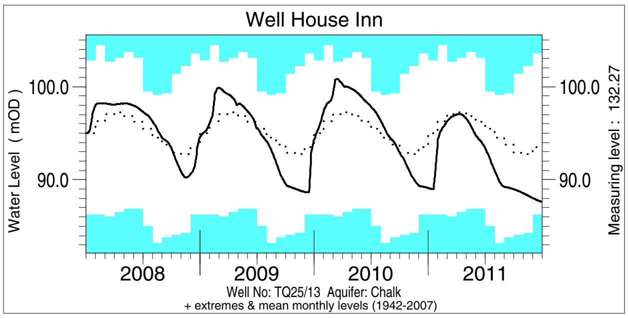


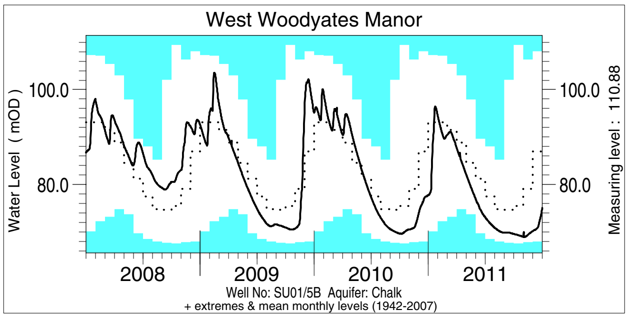


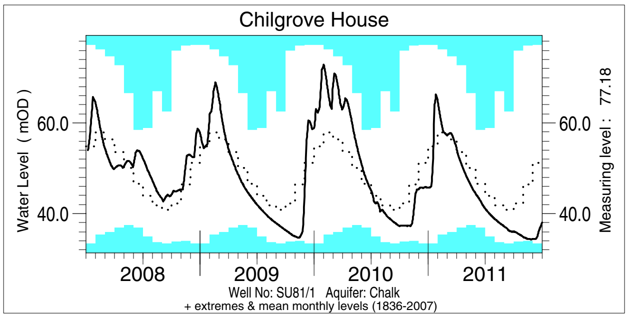


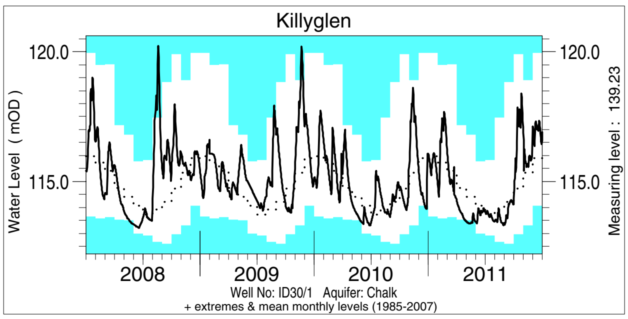


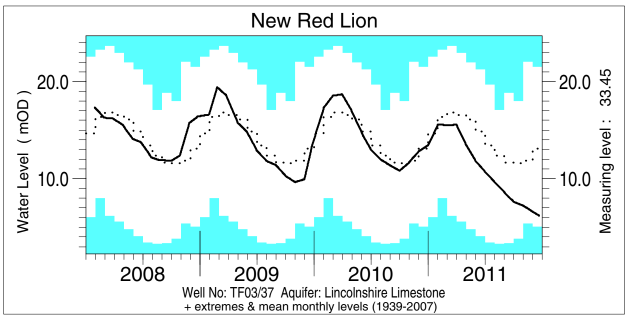






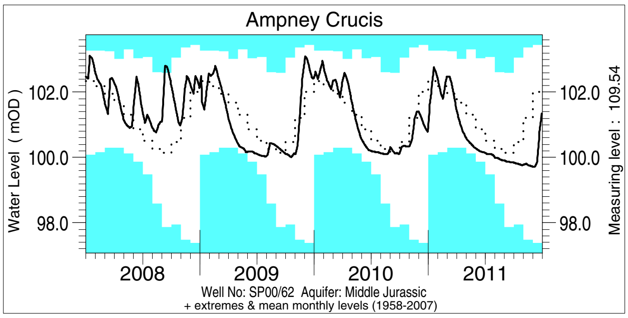


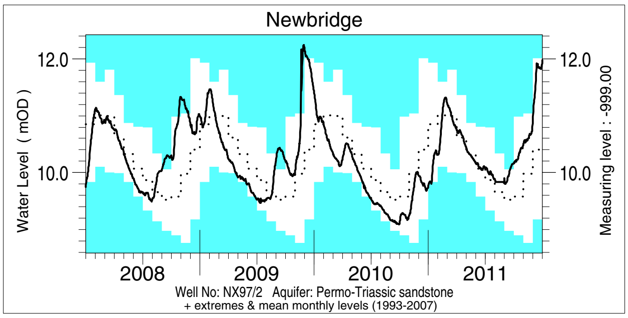


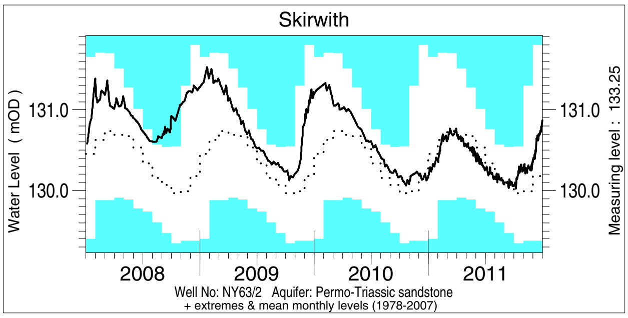


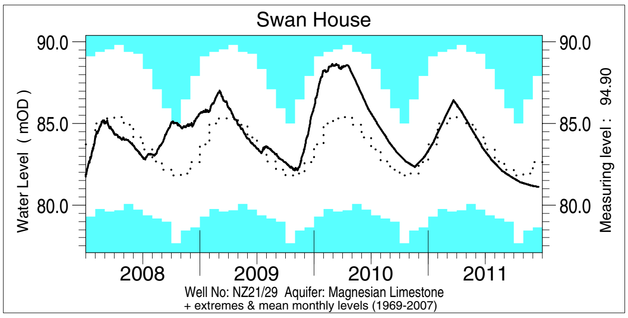
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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 and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation. The latest recorded levels are listed overleaf.

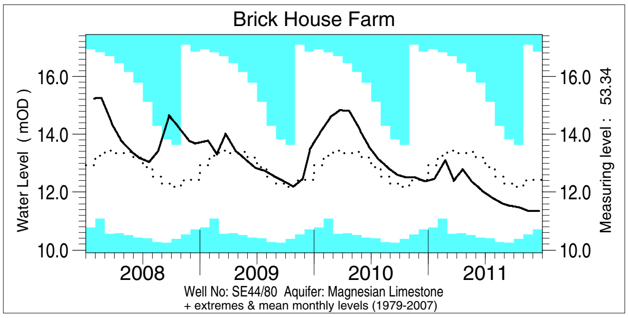
Groundwater . . . Groundwater

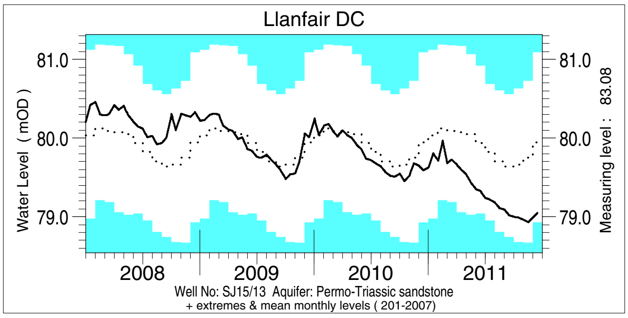


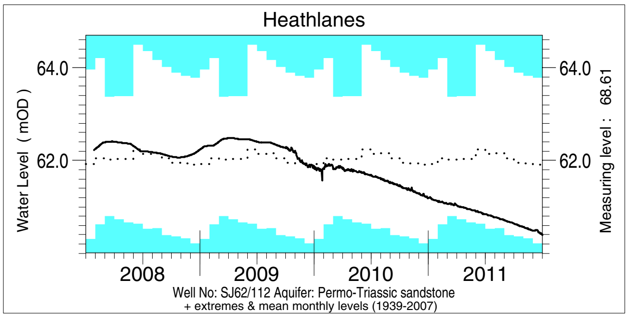


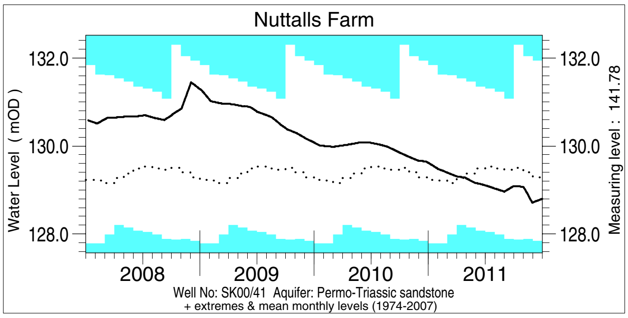


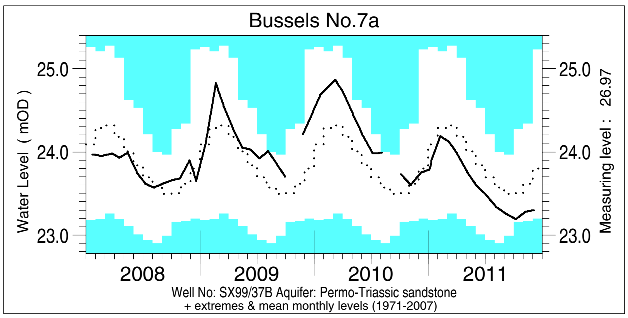


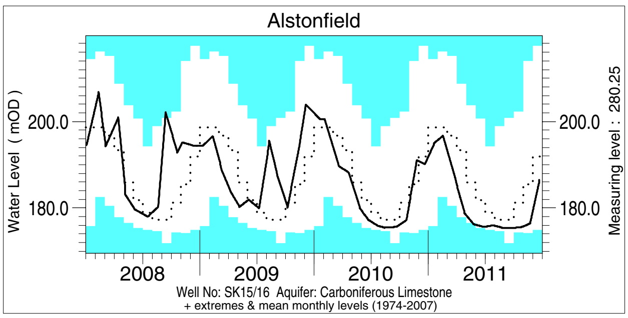








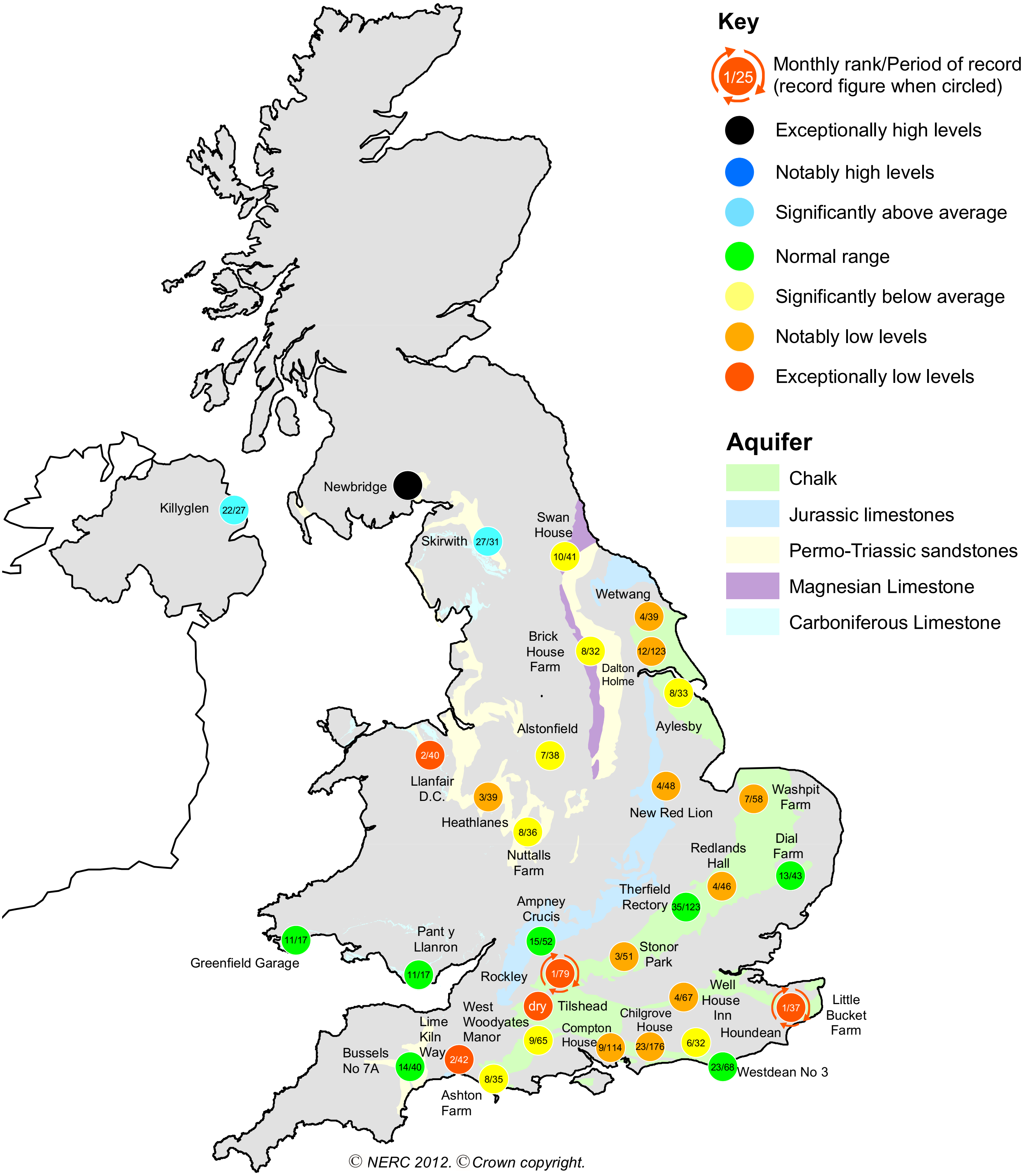




Groundwater levels December 2011 / January 2012

Borehole	Level	Date	Dec av.	Borehole	Level	Date	Dec av.	Borehole	Level	Date	Dec av.
Dalton Holme	12.21	13/12	15.57	Chilgrove House	38.24	31/12	51.92	Brick House Farm	11.36	21/12	12.48
Therfield Rectory	74.91	04/01	77.73	Killyglen (NI)	116.91	31/12	116.06	Llanfair DC	79.05	15/12	79.86
Stonor Park	62.47	03/01	72.33	New Red Lion	6.18	21/12	13.05	Heathlanes	60.39	31/12	61.88
Tilshead	78.11	05/01	86.77	Ampney Crucis	101.68	03/01	101.99	Nuttalls Farm	128.80	30/12	129.59
Rockley	128.29	03/01	133.86	Newbridge	12.04	01/01	10.52	Bussels No.7a	23.61	04/01	23.83
Well House Inn	87.54	03/01	93.50	Skirwith	130.92	01/01	130.31	Alstonfield	186.50	21/12	192.97
West Woodyates	75.05	31/12	87.06	Swan House	81.11	19/12	82.73				

Levels in metres above Ordnance Datum



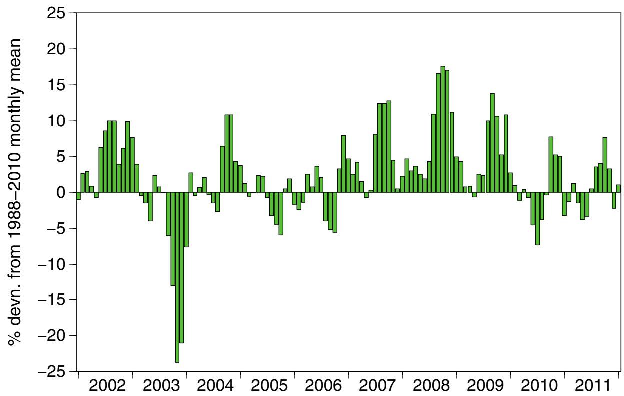
Groundwater levels - December 2011

The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

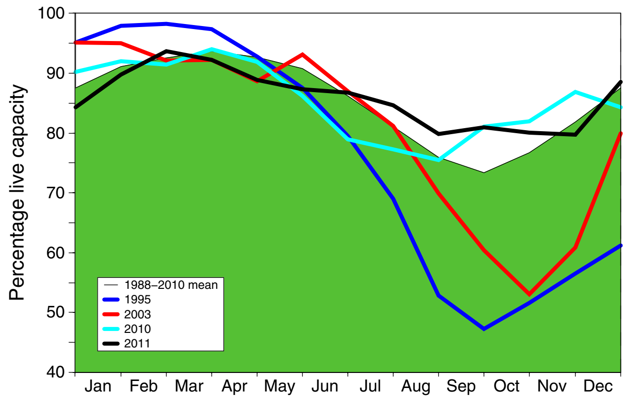
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

Reservoirs . . . Reservoirs . . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs at start of month

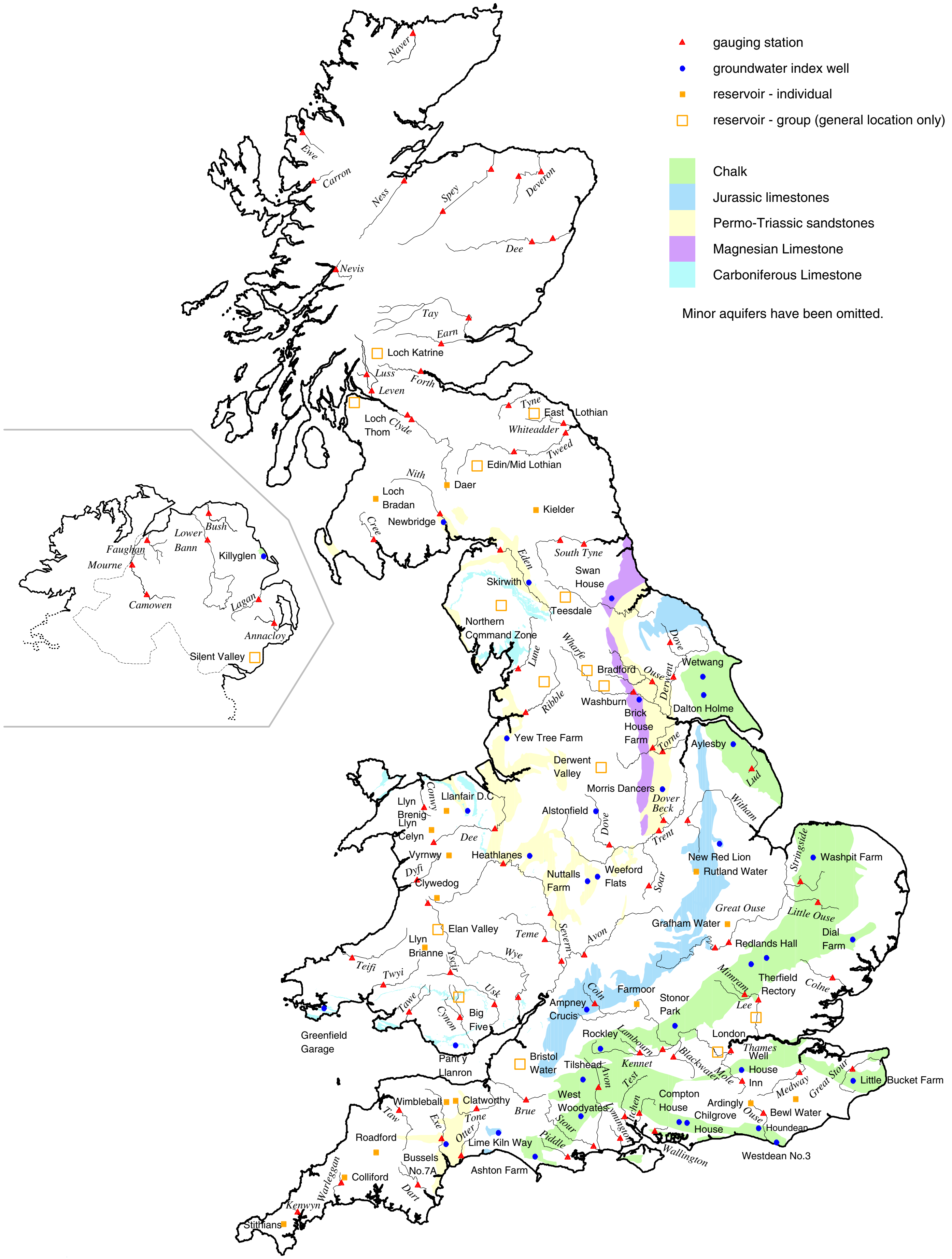
Area	Reservoir		Capacity (Ml)	2011 Nov	Dec	2012 Jan	Jan Anom.	Min Jan	Year* of min	2011 Jan	Diff 12-11
North West	N Command Zone	•	124929	80	81	**100**	13	51	1996	66	34
	Vyrnwy		55146	75	80	**102**	11	35	1996	82	20
Northumbrian	Teesdale	•	87936	91	90	**100**	13	41	1996	90	10
	Kielder		(199175)	(90)	(89)	**(95)**	5	70	1990	89	6
Severn Trent	Clywedog		44922	86	88	**86**	3	54	1996	86	0
	Derwent Valley	•	39525	75	72	**101**	11	10	1996	84	17
Yorkshire	Washburn	•	22035	81	86	**98**	13	23	1996	84	14
	Bradford supply	•	41407	86	90	**100**	10	22	1996	84	16
Anglian	Grafham		(55490)	(84)	(82)	**(84)**	0	57	1998	89	-5
	Rutland		(116580)	(66)	(63)	**(65)**	-17	60	1991	76	-11
Thames	London	•	202828	69	66	**78**	-8	60	1991	89	-11
	Farmoor	•	13822	85	86	**99**	8	71	1991	91	8
Southern	Bewl		28170	43	35	**37**	-36	34	2006	65	-28
	Ardingly*		4685	34	14	**30**	-55	30	2012	85	-55
Wessex	Clatworthy		5364	33	65	**82**	-11	54	2004	56	26
	Bristol WW	•	(38666)	(53)	(53)	**(69)**	-10	40	1991	51	18
South West	Colliford		28540	49	51	**63**	-15	46	1996	79	-16
	Roadford		34500	56	58	**72**	-7	23	1996	69	3
	Wimbleball		21320	44	49	**71**	-14	46	1996	61	10
	Stithians		4967	39	50	**70**	-7	33	2002	77	-7
Welsh	Celyn and Brenig	•	131155	93	95	**98**	5	54	1996	94	4
	Brianne		62140	100	92	**100**	3	76	1996	95	5
	Big Five	•	69762	93	97	**99**	10	67	1996	89	10
	Elan Valley	•	99106	100	100	**100**	3	56	1996	99	1
Scotland(E)	Edinburgh/Mid Lothian	•	97639	100	100	**100**	10	60	1999	88	12
	East Lothian	•	10206	100	100	**100**	5	48	1990	100	0
Scotland(W)	Loch Katrine	•	111363	95	97	**96**	6	75	2008	78	18
	Daer		22412	100	99	**100**	3	83	1996	91	9
	Loch Thom	•	11840	100	100	**100**	4	80	2008	96	4
Northern Ireland	Total+	•	56920	93	91	**98**	12	61	2002	92	6
	Silent Valley	•	20634	88	91	**96**	14	39	2002	92	4

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

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2010 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

*** The monthly record of Ardingly reservoir stocks is under review.**

Location map . . . Location map



National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP)[#] is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision). Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The National River Flow Archive (maintained by CEH) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Rainfall

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

The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

[#] Instigated in 1988

[*]MORECS is the generic name for the Met Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

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

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Selected text and maps are available on the WWW at http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html
Navigate via Hydrological Summary for the UK.

01/12