Hydrological Summary

for the United Kingdom

May 2013

General

May had a distinctly autumnal feel, continuing a pattern of below average temperatures that has persisted throughout spring. It was the coldest May since 1996, and average temperatures over the spring have not been appreciably colder since 1891 in the Central England Temperature series. The incursion of polar airmasses contributed to unusual (but not unprecedented for May) snow accumulations on higher ground. The majority of the UK received significantly above average rainfall; pockets of north-west Scotland and north-east England reported more than twice the long-term monthly average. River flows for the month were generally within the normal range, although high flows characterised impermeable catchments in Scotland as well as groundwater-dominated catchments in central southern England (a continuing response to wet conditions in 2012). Moderate medium-term rainfall deficiencies characterise much of the UK; this is reflected in five-month runoff deficiencies in impermeable northern and western areas. Groundwater resources remain healthy, with above average water levels in all of the main aquifers (other than the Carboniferous Limestone of the Peak District), and reservoir stocks remain very healthy, generally within 10% of average, with stocks within 7% of capacity for all constituent countries of the UK. Following the significant hydrological volatility of the three previous years, 2013 thus far has been relatively unremarkable by comparison, and the water resources outlook remains very favourable.

Rainfall

For the third consecutive month, airflows from the north-east quadrant were dominant in May, bringing brisk winds and interacting with frontal systems to produce snow in places over higher ground in Scotland, Wales and Devon. Scotland witnessed pulses of heavy rainfall throughout May – Highland, Solway and Clyde all registered at least 170% of their monthly average – but southern areas of the UK were largely fine and dry to begin the month, before frontal systems began to predominate thereafter. A deep depression swept across the UK on 14th/15th, bringing heavy rainfall (e.g. 72mm at Pembrey, Carmarthenshire), gusty winds (e.g. 65mph across the south-west causing power cuts in Cornwall), and snow over higher ground (e.g. 5cm in Shropshire). Large areas of Scotland, Wales, Northern Ireland and northern and central England received more than 125% of average monthly rainfall, and this was the first year since 2007 in which May was wetter than normal. North-west England and the Shetland Islands apart, spring rainfall accumulations were within 12% of average for all regions of the UK. Moderate rainfall deficiencies over five months characterise northern and western areas; excepting the drought in north-west England in 2010, it has been the driest start to a year in this region for 50 years. There has not been an appreciably drier start to the year in the Shetlands since 1941.

River flows

Generally, river flows were below average in early May, but spate conditions were widespread over the second half of the month. A deep depression on 14th/15th resulted in the highest flows of the month in many catchments across Wales and the south-west of England; flooded roads and landslides were reported, and the Tywi registered its highest May flow on record. Further rainfall on 18th, particularly focused on north-east and north-west England, led to localised flash flooding and a bridge collapse in County Durham; the Tyne and Eden, as well as the Faughan in Northern Ireland, registered their highest May flows on record. The South Tyne recorded its second highest flow in any month in a series from 1962, with the previous maximum May flow exceeded by more than 50% for the second consecutive year. In response to the succession of frontal systems throughout May, rivers across north-west Scotland recorded twice their monthly average flow. Daily flows on the Ewe were above average throughout May, and the Naver recorded its highest average May flow on record. Snowmelt would have been a significant component of flow in upland catchments, but generally melt rates were not exceptionally high. Outflows from the constituent countries of the UK were within the normal seasonal range, although May outflows from Scotland have not been appreciably higher since 1986.

Groundwater

Above average May rainfall was not sufficient to prevent a seasonally normal increase in soil moisture deficits across much of England, although water levels generally remained above average in most of the major aquifers. In the Chalk, the seasonal recession has typically been well established for several months and although levels were above average in May, the risk of groundwater flooding diminished. Water levels were still rising at Dial Farm in southern East Anglia, where the Chalk is concealed by low permeability superficial deposits. In the Permo-Triassic sandstones, water levels remained seasonally high in the south-west and north-west, despite recent falls, with a new monthly maximum level recorded at Newbridge. In the slower-responding Permo-Triassic sandstones of the Midlands, levels were generally still rising. In the Upper Greensand of south-west England, levels fell for the third consecutive month but remained above the previous May maximum. In the Magnesian Limestone, water levels declined but remained high. In the Jurassic limestone aquifers, levels were in the normal range at New Red Lion in the Lincolnshire Limestone and Ampney Crucis in the Cotswolds, but were locally high further south-west. In the Carboniferous Limestone, levels were below average in the Peak District and parts of south Wales. The groundwater resources outlook for the summer is favourable; levels are likely to be average to above average by the autumn, prior to the commencement of the groundwater recharge season.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

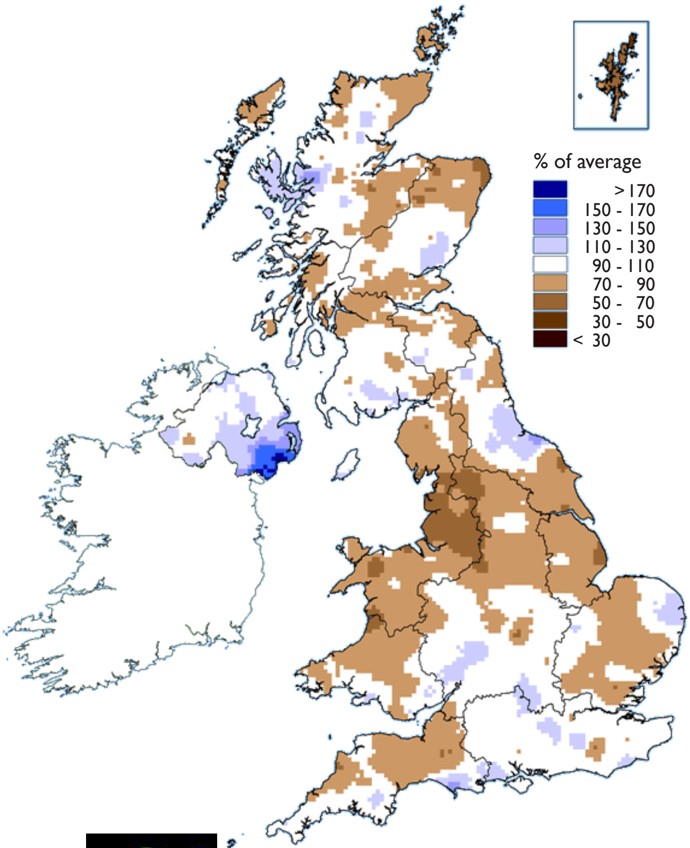
Area	Rainfall	May 2013	Mar13 – May13	RP	Jan13 – May13	RP	Oct13 – May13	RP	Apr12 – May13	RP
United	mm	**91**	217		383		824		1510	
Kingdom	%	**144**	98	2-5	91	2-5	108	2-5	125	>100
England	mm	**70**	165		282		657		1287	
	%	**127**	94	2-5	89	2-5	117	5-10	140	>100
Scotland	mm	**118**	288		513		1040		1773	
	%	**162**	101	2-5	90	2-5	100	2-5	111	5-10
Wales	mm	**108**	245		470		1062		1948	
	%	**142**	90	2-5	88	2-5	108	2-5	129	50-80
Northern	mm	**110**	260		468		806		1446	
Ireland	%	**162**	112	2-5	107	2-5	104	2-5	116	20-35
England &	mm	**75**	176		308		713		1379	
Wales	%	**130**	93	2-5	89	2-5	115	5-10	138	>100
North West	mm	**86**	182		329		832		1700	
	%	**130**	78	2-5	75	10-15	102	2-5	131	80-120
Northumbria	mm	**91**	194		322		687		1425	
	%	**157**	104	2-5	98	2-5	121	8-12	152	>>100
Midlands	mm	**82**	160		271		596		1217	
	%	**152**	96	2-5	91	2-5	116	5-10	142	>100
Yorkshire	mm	**82**	161		266		624		1302	
	%	**149**	90	2-5	83	2-5	112	2-5	142	>100
Anglian	mm	**51**	123		195		460		933	
	%	**111**	90	2-5	86	2-5	117	2-5	136	40-60
Thames	mm	**61**	166		265		590		1113	
	%	**115**	105	2-5	97	2-5	124	5-10	140	80-120
Southern	mm	**52**	165		286		667		1203	
	%	**105**	102	2-5	96	2-5	122	5-10	139	30-50
Wessex	mm	**61**	174		320		763		1427	
	%	**108**	95	2-5	94	2-5	125	8-12	148	>100
South West	mm	**78**	231		440		1069		1863	
	%	**114**	98	2-5	91	2-5	121	8-12	140	>100
Welsh	mm	**105**	239		457		1031		1898	
	%	**141**	91	2-5	89	2-5	109	2-5	130	60-90
Highland	mm	**148**	353		605		1186		1897	
	%	**189**	106	2-5	89	2-5	94	2-5	100	2-5
North East	mm	**81**	203		327		670		1284	
	%	**129**	100	2-5	89	2-5	103	2-5	120	5-10
Tay	mm	**99**	256		448		947		1652	
	%	**135**	99	2-5	86	2-5	103	2-5	118	8-12
Forth	mm	**80**	219		400		841		1594	
	%	**121**	95	2-5	89	2-5	105	2-5	127	40-60
Tweed	mm	**73**	204		354		767		1574	
	%	**111**	99	2-5	94	2-5	115	5-10	147	>>100
Solway	mm	**128**	304		549		1117		1999	
	%	**170**	109	2-5	100	2-5	111	5-10	129	>100
Clyde	mm	**137**	322		621		1272		2115	
	%	**173**	98	2-5	92	2-5	105	2-5	111	5-10

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

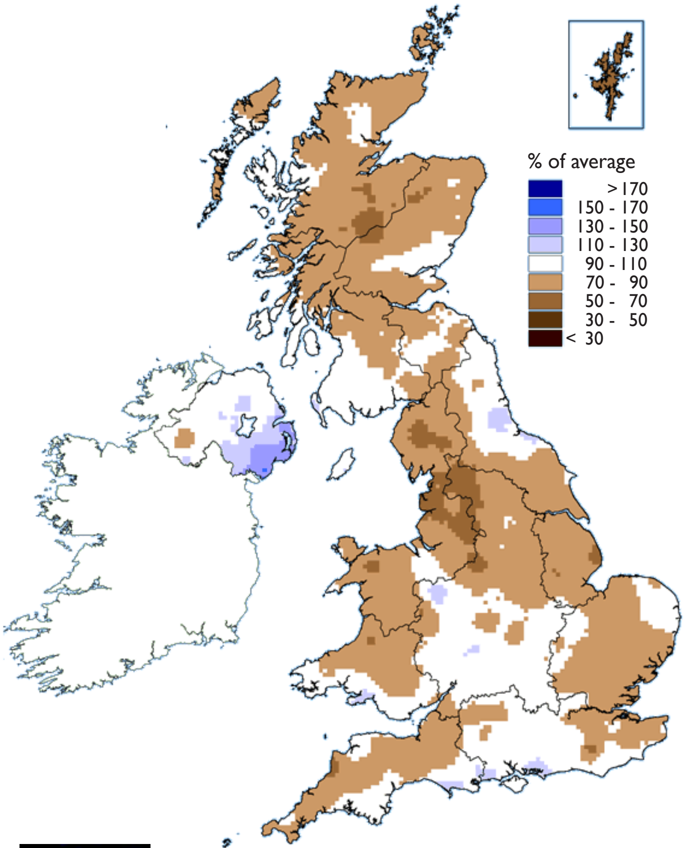
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals since December 2012 are provisional.

Rainfall . . . Rainfall . . .

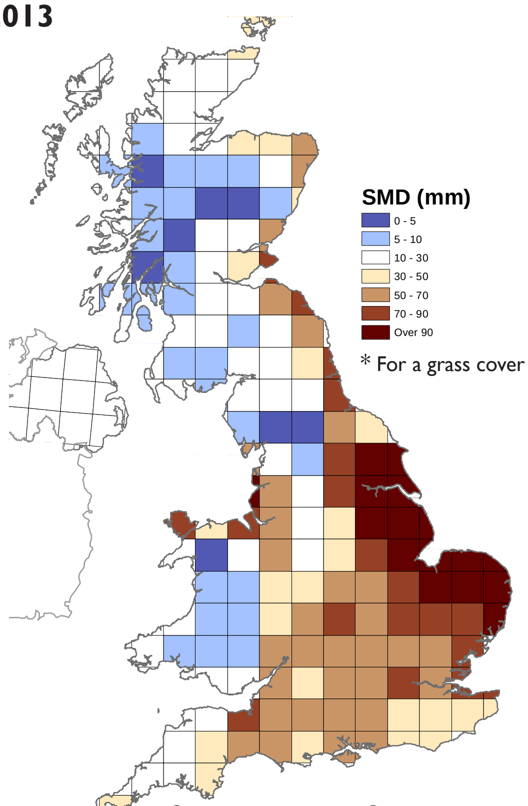
March 2013 - May 2013 rainfall as % of 1971-2000 average



January 2013 - May 2013 rainfall as % of 1971-2000 average



MORECS Soil Moisture Deficits* May 2013



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Met Office 3-month outlook Updated: June 2013

For June, there is a large degree of uncertainty, but on balance above-average rainfall is more likely than below-average. For the June-July-August period as a whole, above-average rainfall is also more probable than below-average rainfall.

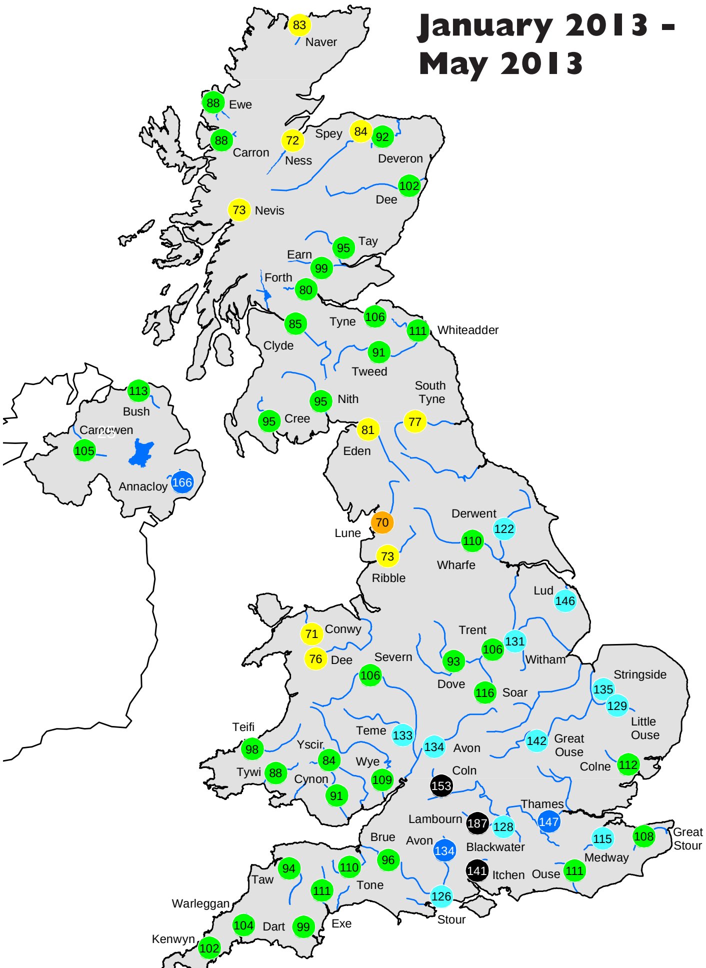
The probability that UK precipitation for June-July-August will fall into the driest of our five categories is around 15% and the probability that it will fall into the wettest category is around 20% (the 1981-2010 probability for each of these categories is 20%).

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 2013 - May 2013



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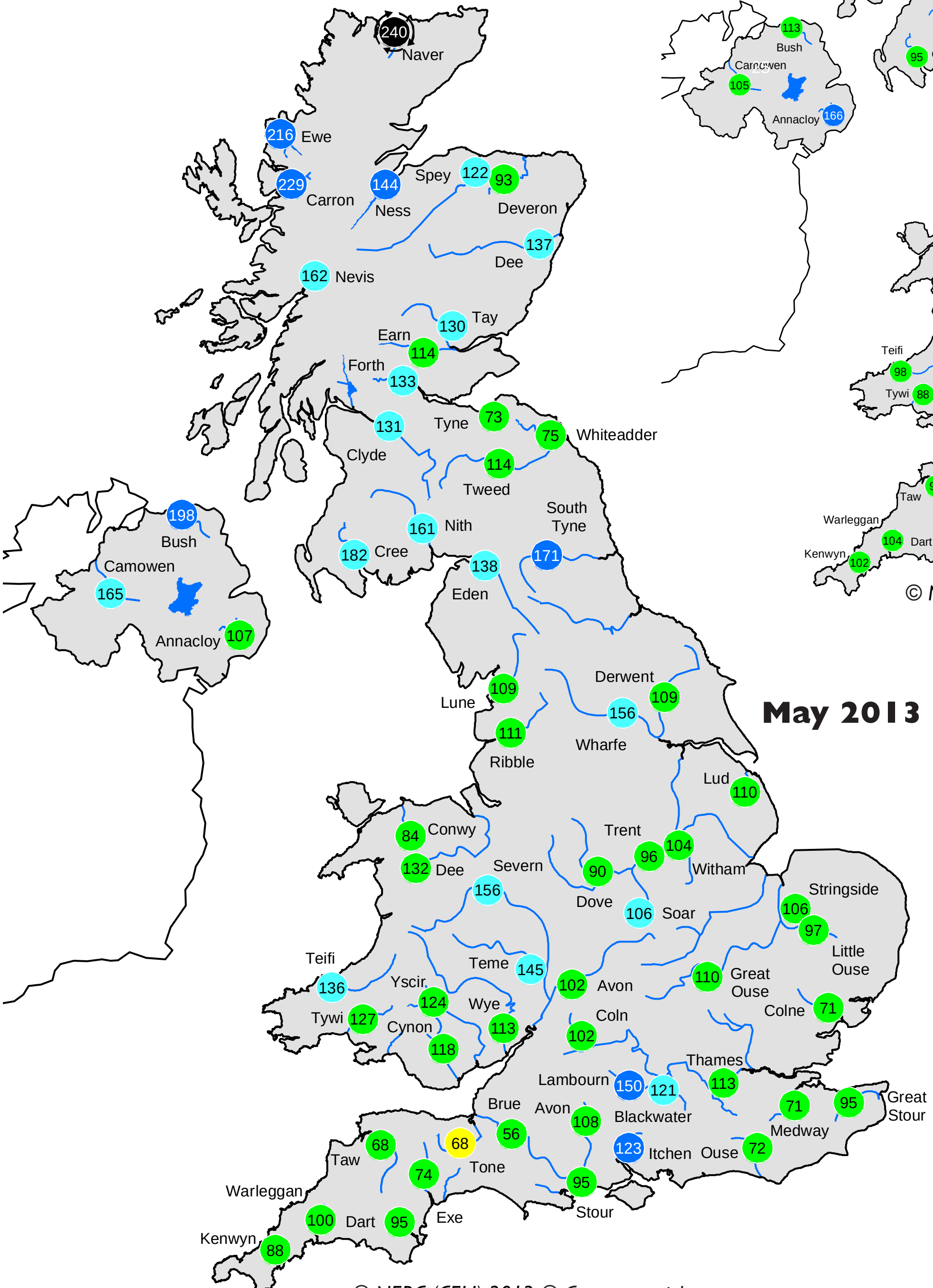
May 2013



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Key

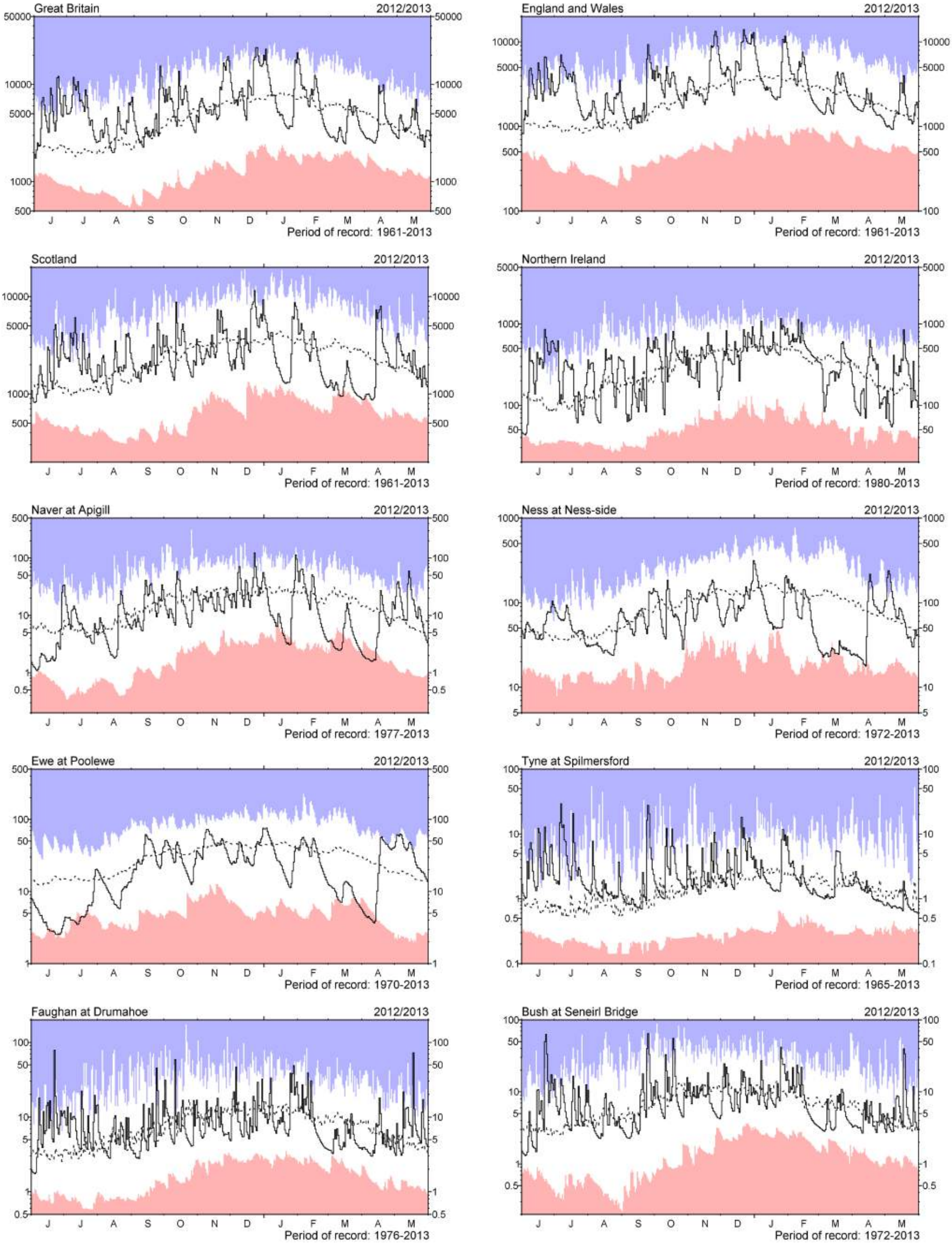
- 25 % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*Based on ranking of the monthly flow**

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.

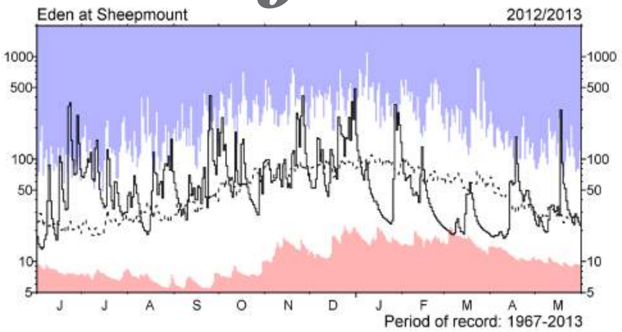
River flow . . . River flow . . .

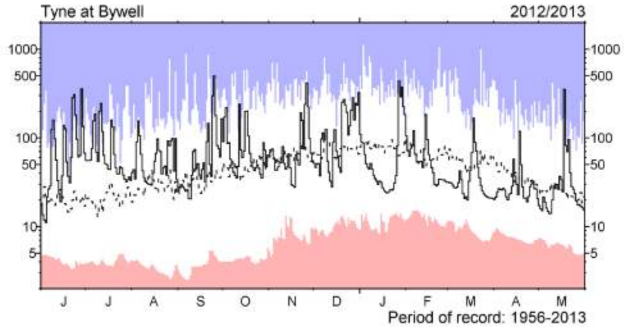


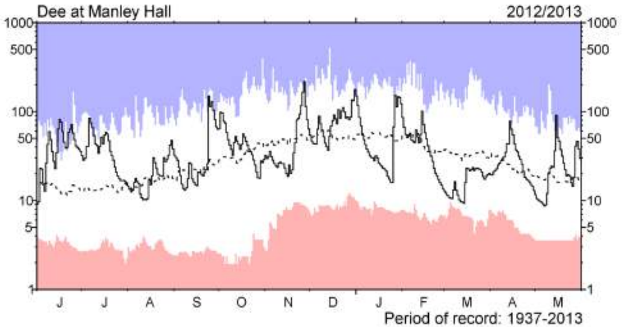
River flow hydrographs

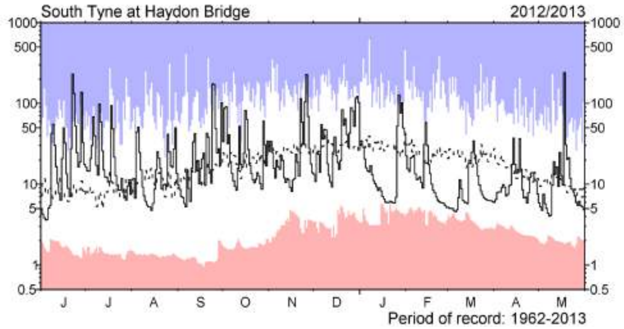
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to June 2012 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

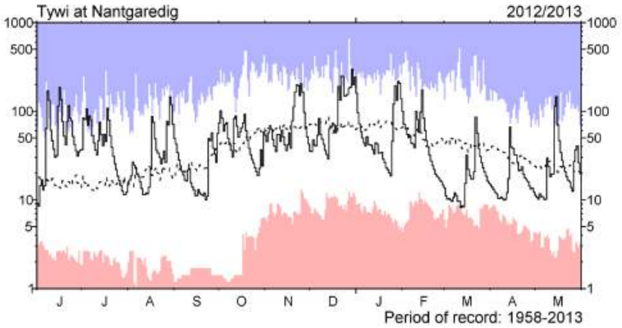
River flow . . . River flow . . .

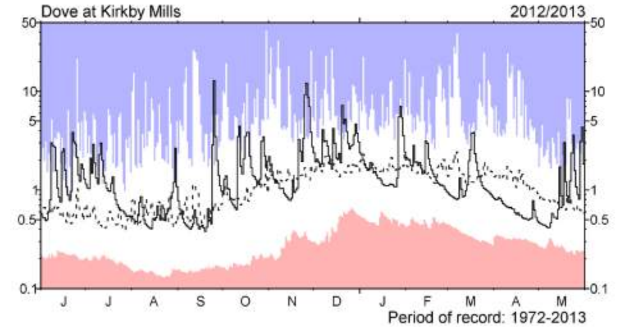


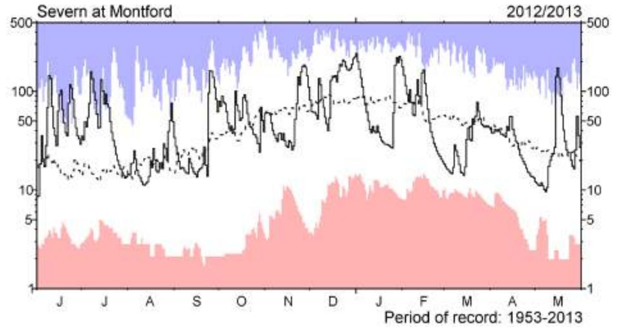


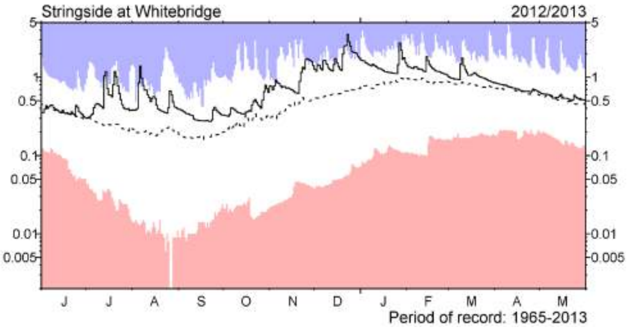


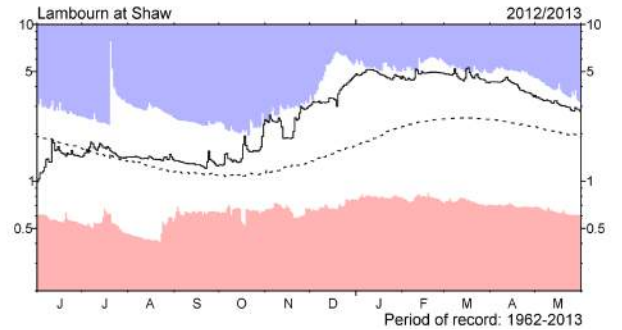


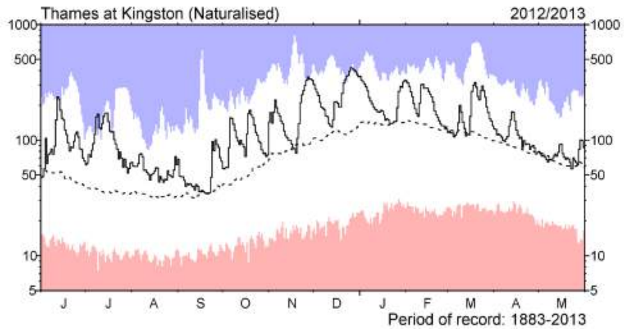


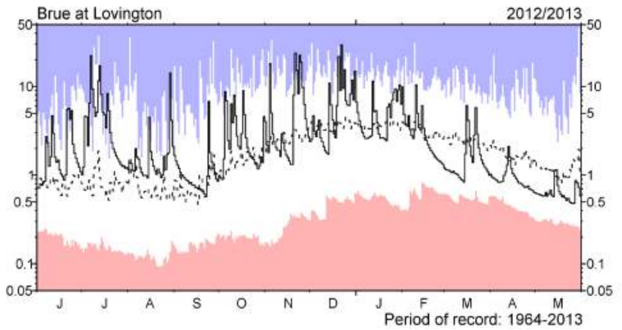


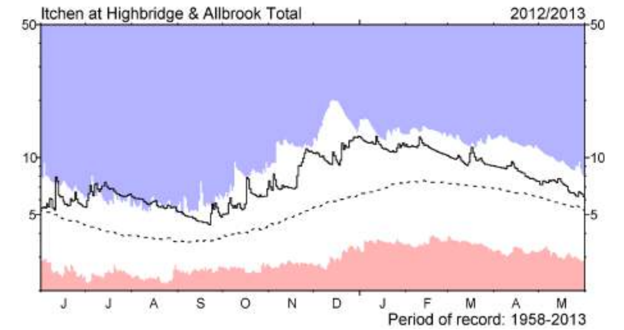




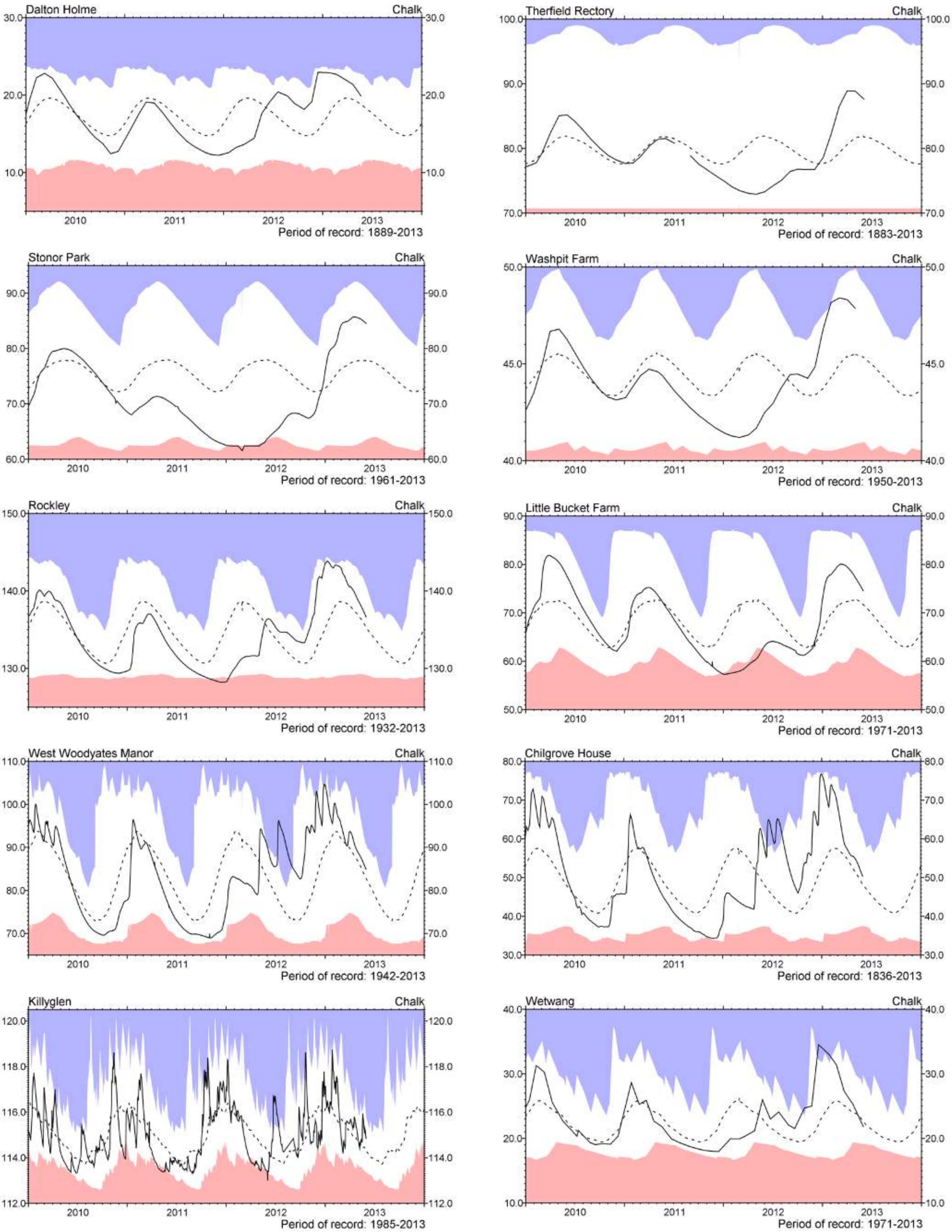






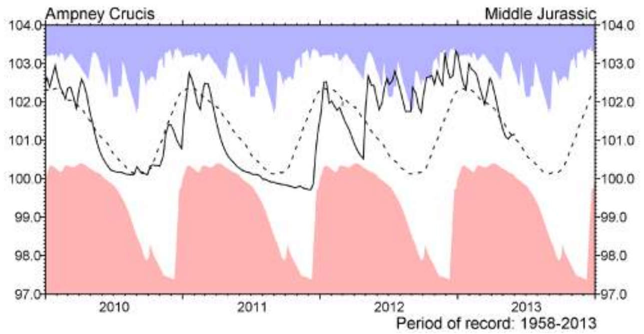


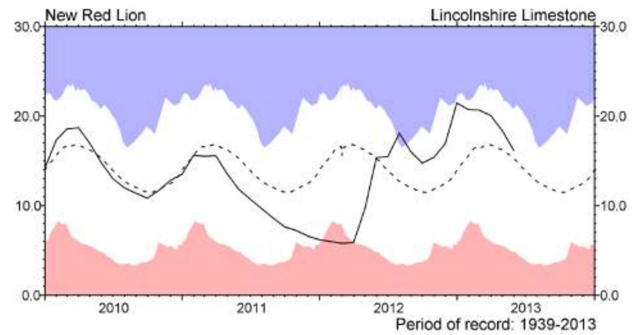
Groundwater . . . Groundwater

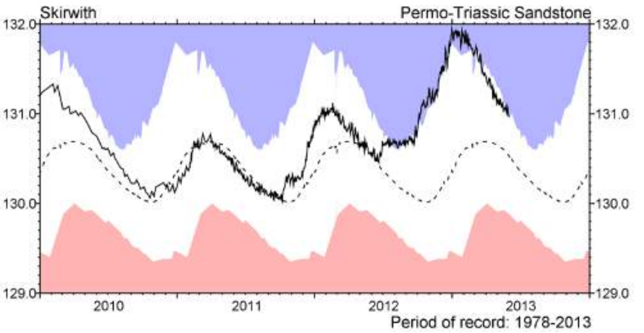


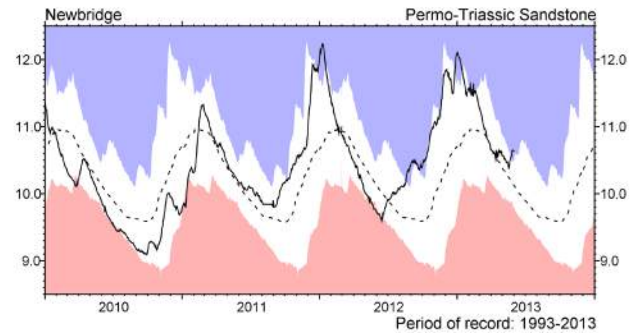
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

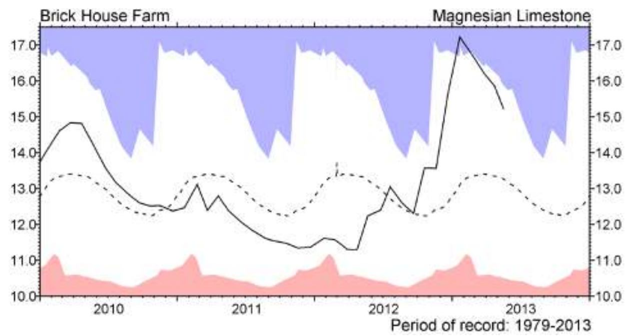
Groundwater ... Groundwater

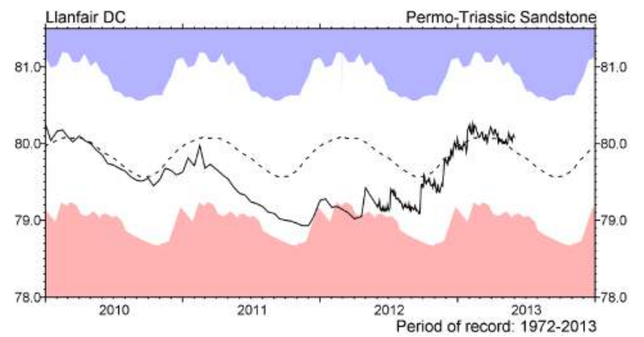


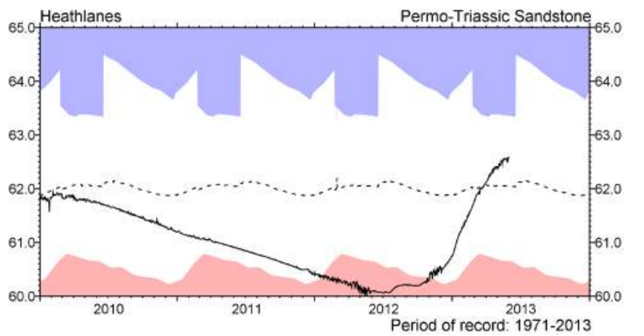


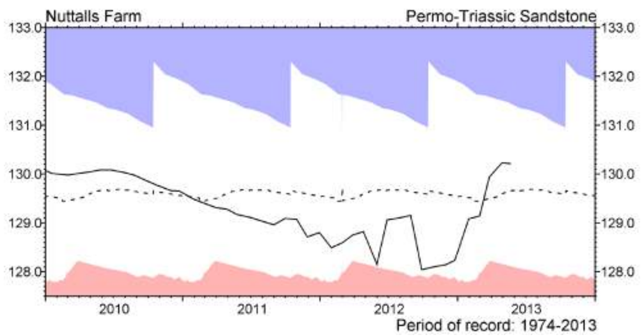


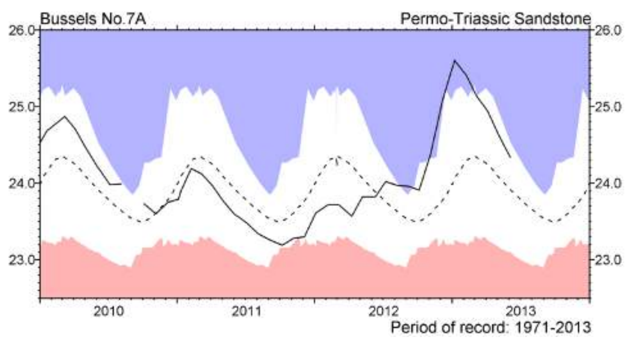


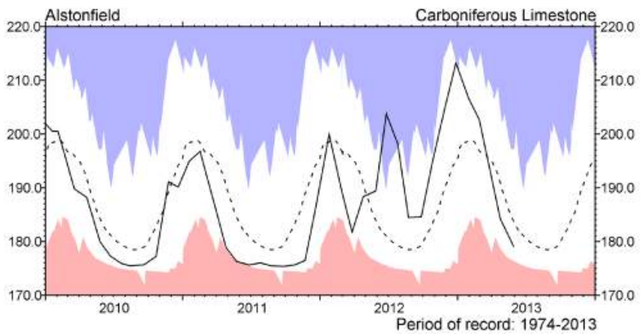












Groundwater levels May / June 2013

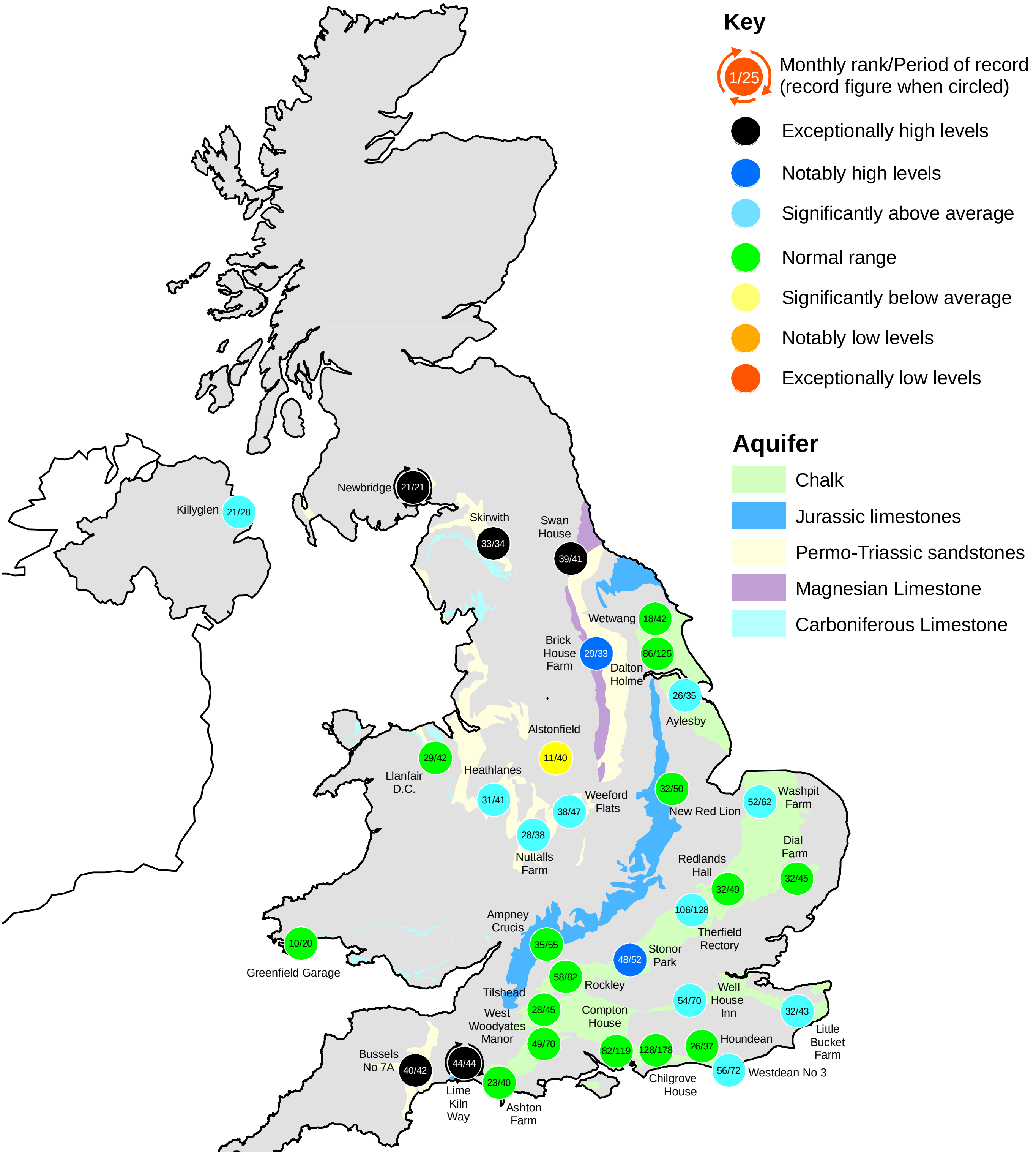
Borehole	Level	Date	May av.
Dalton Holme	19.87	22/05	18.94
Therfield Rectory	87.60	03/06	81.59
Stonor Park	84.54	31/05	77.63
Tilshead	89.84	31/05	89.92
Rockley	136.64	31/05	136.15
Well House Inn	99.14	31/05	96.91
West Woodyates	84.94	31/05	84.63

Borehole	Level	Date	May av.
Chilgrove House	50.23	31/05	49.02
Killyglen (NI)	114.85	31/05	114.39
Wetwang	21.83	31/05	23.49
Ampney Crucis	101.15	31/05	101.24
New Red Lion	16.16	31/05	15.62
Skirwith	130.96	31/05	130.61
Newbridge	10.63	31/05	10.23

Borehole	Level	Date	May av.
Brick House Farm	15.22	17/05	13.26
Llanfair DC	80.08	31/05	79.95
Heathlanes	62.58	31/05	61.96
Nuttalls Farm	130.21	21/05	129.59
Bussels No.7a	24.34	04/06	24.00
Alstonfield	179.10	29/05	185.98

Levels in metres above Ordnance Datum

Groundwater...Groundwater



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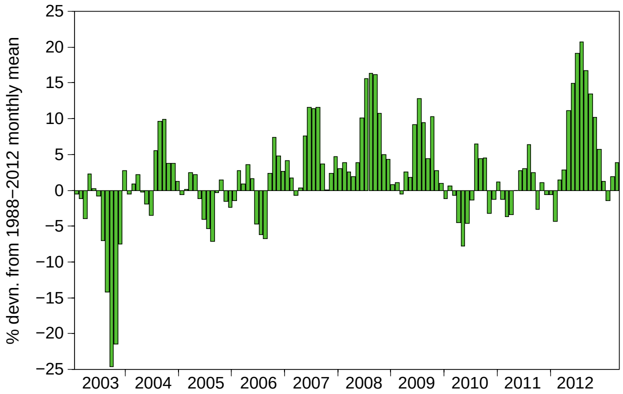
Groundwater levels - May 2013

The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. The rankings are designed as a qualitative indicator, and ranks at extreme levels, and when levels are changing rapidly, need to be interpreted with caution.

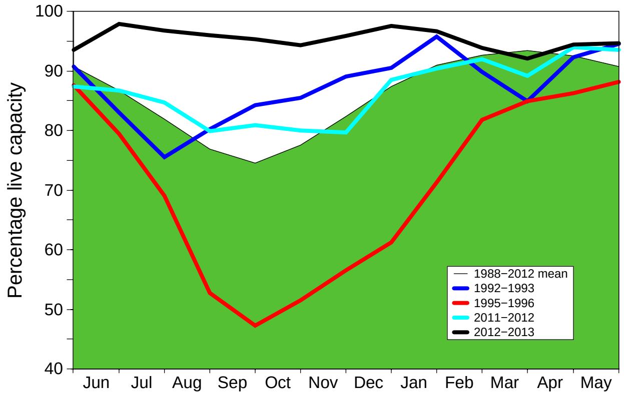
Notes:
i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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 end of month

Area	Reservoir		Capacity (Ml)	2013 Mar	2013 Apr	2013 May	May Anom.	Min May	Year* of min	2012 May	Diff 13-12
North West	N Command Zone	•	124929	81	87	83	2	50	1984	80	3
	Vyrnwy		55146	92	100	98	11	69	1984	94	4
Northumbrian	Teesdale	•	87936	83	94	95	9	64	1991	90	5
	Kielder		(199175)	86	90	92	0	85	1989	93	-1
Severn Trent	Clywedog		44922	97	99	99	2	83	1989	100	-1
	Derwent Valley	•	39525	90	83	85	-3	56	1996	96	-11
Yorkshire	Washburn	•	22035	95	93	91	4	72	1990	94	-3
	Bradford supply	•	41407	91	93	91	5	70	1996	92	-1
Anglian	Grafham		(55490)	88	95	96	2	72	1997	95	1
	Rutland		(116580)	96	95	95	4	75	1997	95	0
Thames	London	•	202828	96	96	97	3	83	1990	98	-1
	Farmoor	•	13822	80	98	97	0	90	2002	99	-2
Southern	Bewl		28170	100	100	99	12	57	1990	79	20
	Ardingly**		4685	100	100	100	1	89	2012	89	11
Wessex	Clatworthy		5364	100	93	85	-1	67	1990	96	-11
	Bristol WW	•	(38666)	96	95	90	2	70	1990	96	-6
South West	Colliford		28540	100	99	97	12	52	1997	80	17
	Roadford		34500	93	91	88	6	48	1996	85	3
	Wimbleball		21320	100	100	94	3	74	2011	99	-5
	Stithians		4967	100	93	86	0	66	1990	93	-7
Welsh	Celyn and Brenig	•	131155	99	100	100	3	82	1996	100	1
	Brianne		62140	96	99	100	5	84	2011	98	2
	Big Five	•	69762	96	96	96	6	70	1990	96	0
	Elan Valley	•	99106	92	95	100	7	81	2011	95	5
Scotland(E)	Edinburgh/Mid Lothian	•	97639	93	98	96	6	52	1998	94	2
	East Lothian	•	10206	100	100	100	3	84	1990	100	0
Scotland(W)	Loch Katrine	•	111363	81	92	92	5	66	2001	80	12
	Daer		22412	77	78	77	-15	70	1994	98	-21
	Loch Thom	•	11840	90	89	91	0	74	2001	93	-2
Northern Ireland	Total+	•	55540	100	98	95	11	69	2008	82	13
	Silent Valley	•	20634	100	99	96	16	56	2000	76	20

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

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

+ excludes Lough Neagh

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 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

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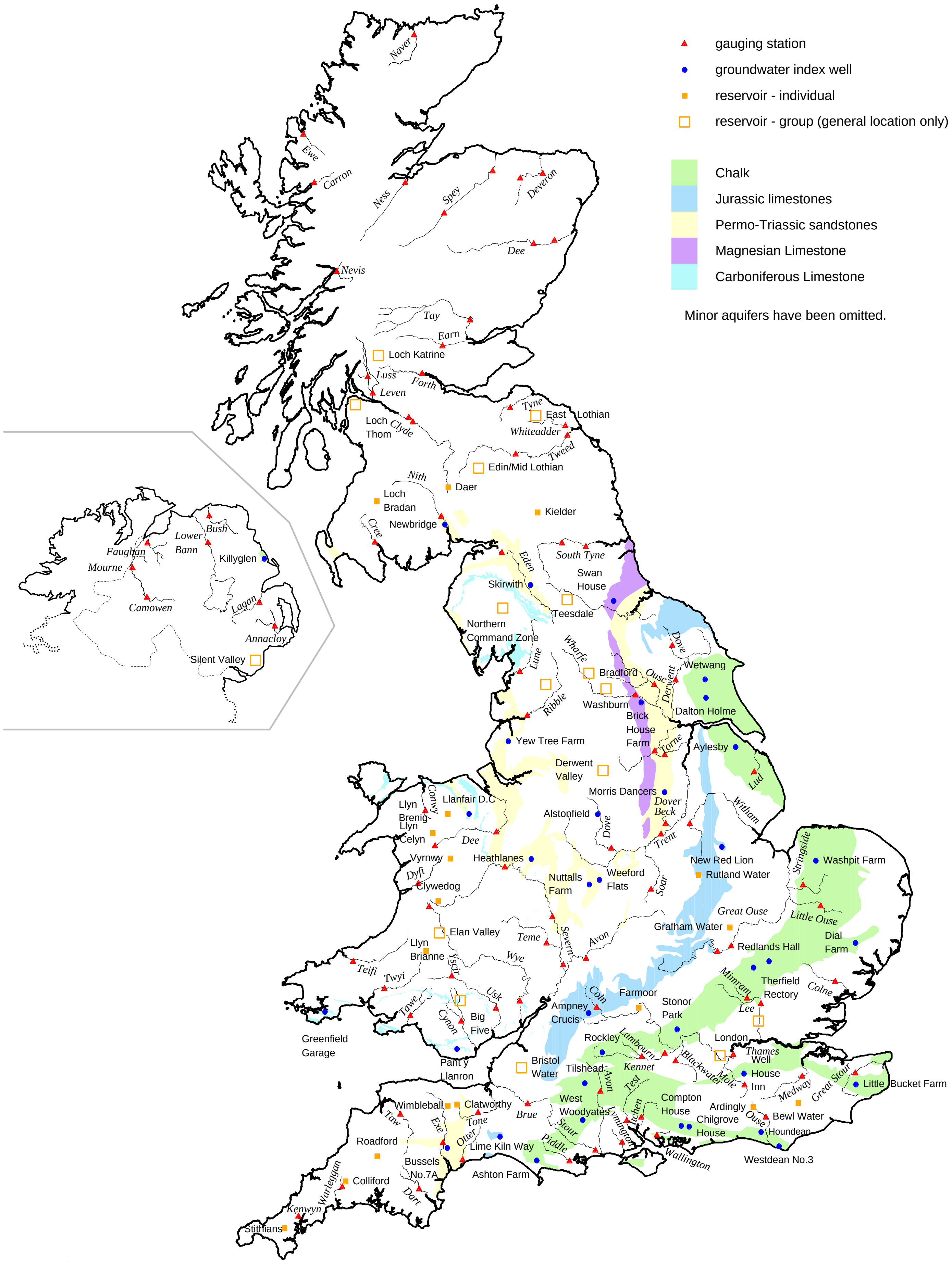
Location map…Location map



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National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP) was instigated in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS) – both are component bodies of the Natural Environment Research Council (NERC). 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.

Data Sources

River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru, the Scottish Environment Protection Agency (SEPA) and, for Northern Ireland, the Rivers Agency and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (high flow and low flow 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.

Most rainfall data are provided by the Met Office (address opposite).

To allow better spatial differentiation the monthly rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA.

The monthly, and n-month, rainfall figures have been produced by the Met Office, National Climate Information Centre (NCIC) and are based on gridded data from raingauges. They include a significant number of monthly raingauge totals provided by the EA and SEPA. The Met Office NCIC monthly rainfall series extends back to 1910 and forms the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM (2005) available at http://www.metoffice.gov.uk/climate/uk/about/Monthly_gridded_datasets_UK.pdf

The regional figures for the current month are based on limited raingauge networks so these (and the return periods associated with them) should be regarded as a guide only.

The Met Office NCIC monthly rainfall series are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

From time to time the Hydrological Summary may also refer to evaporation and soil moisture figures. These are obtained from MORECS, the Met Office services involving the routine calculation of evaporation and soil moisture throughout the UK.

06/2013

For further details please contact:

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100
Email: enquiries@metoffice.gov.uk

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

Enquiries

Enquiries should be addressed to:

Hydrological Summaries for the UK
Centre for Ecology & Hydrology
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

Tel.: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:
http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html

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