Hydrological Summary
for the United Kingdom

General

July began with heat-wave conditions, but the majority of the month was distinctly autumnal, as an unseasonal southerly track of the jet stream contributed to exceptionally unsettled conditions. July was cool, windy and very wet (especially in the west). Overall, it was the wettest July since 1888 in England and Wales and a third wet July in succession; only pre-1800 records (when data are less reliable) contain a wetter 3-year sequence of Julys. Relatively dry conditions had prevailed through the first half of 2009. Consequently, in western areas, the high rainfall caused a rapid decline in soil moisture deficits (SMDs) and a brisk increase in river flows, leading to exceptional monthly runoff totals and new July peak flows in some index rivers. Fluvial flooding was generally localised in extent and impact, but flash flooding was frequent and widespread. The wet weather resulted in substantial inflows to many reservoirs; only Rutland, Bewl and Ardingly had below average stocks, and overall stocks for England & Wales are 10% above average for the start of August. Soils in aquifer areas were still dry enough to inhibit recharge, so groundwater levels remain largely within the normal range. With the outlook for the remainder of the summer suggesting further unsettled weather, and early indications for above average winter rainfall, it is likely that seasonal recovery in runoff and recharge will begin considerably earlier than usual.

July 2009

Rainfall

A prolonged arid episode, which had persisted from mid-June in some areas, continued into the first few days of July. Associated with the heat-wave, thunderstorms brought torrential downpours to some localities, particularly to western Scotland and northern England, with 53mm falling in 40 minutes at Copley (Durham) on the 2nd. From the 5th, a series of slow-moving low pressure systems crossed the British Isles, bringing prolonged and heavy rainfall which triggered widespread summer spates. Notable 24-hour totals were registered in localities as far apart as Hastings (90mm on the 7th), Cardinham (Cornwall) and Chillingham (Northumbria) which received 94mm and 84mm respectively on the 16-17th. The sustained frontal rainfall contributed to exceptional monthly totals; all regions received substantially above average rainfall, and totals were twice (three times in parts of the west) the average across upland England, Wales and eastern Scotland. South West and North West regions registered their highest July totals in records from 1914, whilst, provisionally, Bude (Cornwall) had its sixth wettest month since 1880. Correspondingly, short-term (3-5 month) rainfall accumulations were appreciably above average everywhere except the South East; Scotland experienced its second wettest March - July total (after 2002) in a 141-year series. Rainfall for the year so far is now above average across most of upland Britain, further underlining the exceptional nature of the recent rainfall; the late spring - early summer was generally dry in England and Wales, so these accumulations reflect a disproportionate contribution from July.

River flows

Seasonal river flow recessions were terminated abruptly in early July in a majority of responsive index rivers, as soils wetted up following successive waves of frontal rainfall. Flood alerts were common as river levels rose rapidly. A majority of incidents were caused by flash flooding, frequently associated with convective cells, and often focused on urban areas, including parts of Glasgow, Belfast and London (where flooding from overwhelmed drainage caused transport disruption on the 7th). High river levels caused localised flooding in western England, south Wales and north-east England – provisional data suggest the Wear reached a new maximum level in a >50 year record, causing flooding in Durham. New maximum peak flows for July were recorded in some northern and western index catchments (e.g. the Teifi, Taw, Dove and Whiteadder), whilst many more approached previous maxima. The Warleggan (Cornwall) registered its second highest peak flow (for any month) in a 40-year record. With the exception of south-east England and north-west Scotland, monthly runoff totals were notably high (exceptionally so in some catchments in Cornwall and south Wales), leading to above average runoff accumulations in the short term. Over the longer-term (> 3 months), runoff is generally in the normal range – below average accumulations in some catchments reflect the dry antecedent conditions. For the third year in succession, high river flows have been a feature of the summer months, although in 2009 the runoff has (so far) been concentrated in July in much of the country, whereas in 2007 & 2008, it extended over a much longer period.

Groundwater

Following the relatively dry spring, above-average soil moisture deficits (SMDs) extended across much of the UK at the end of June. The exceptionally wet July has substantially altered this picture; deficits were largely eliminated in western areas, which experienced the brunt of the rainfall, and were reduced in some outcrop areas to the east. SMDs for July for England & Wales as a whole were comparable to those in 2008, but much higher than in 2007. There is no close modern precedent to the 3-year sequence of wet end-of-July soil conditions. SMDs were still higher than average across much of eastern England, and sufficient to limit the potential for recharge from the sustained July rainfall. Furthermore, the most exceptional rainfall fell away from the main aquifer areas. The groundwater outlook is therefore broadly similar to the situation in June; levels in most aquifers are close to their seasonal average although, in the southern Chalk and some limestones, levels are below average where rainfall accumulation has been lower. Any groundwater response to the July rainfall is likely to take several weeks to become apparent, although the sustained rainfall contributed to rises in level at Killyglen (Chalk, Northern Ireland) and in some western Permo-Triassic Sandstone boreholes; Bussels No 7a is likely to be at a record monthly high in August.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

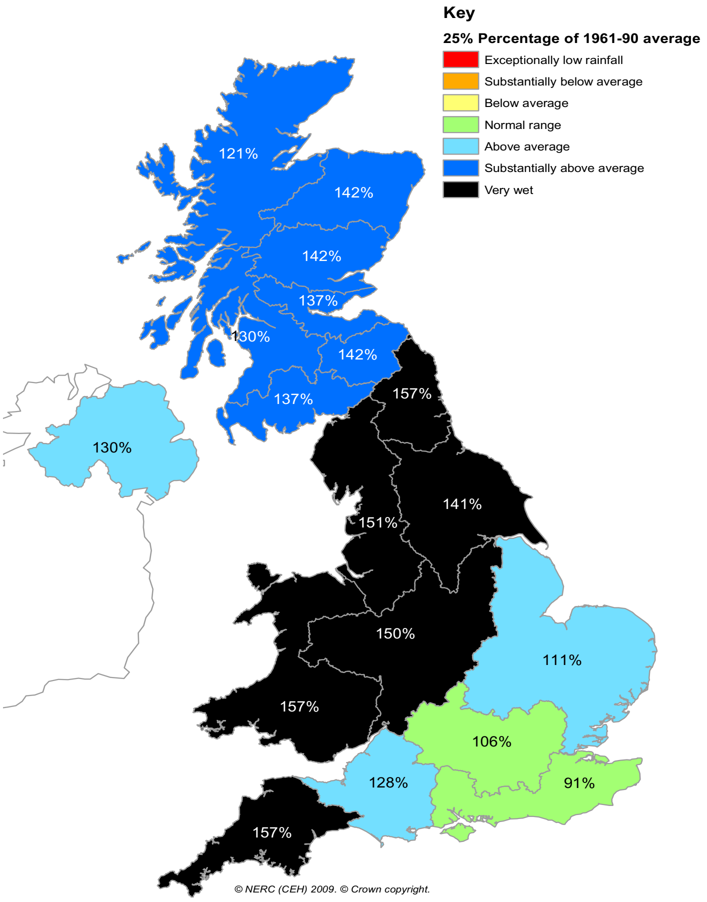
Area	Rainfall	Jul 2009	May 09 - Jul 09		Mar 09 - Jul 09		Jan 09 - Jul 09		Aug 08 - Jul 09	
England & Wales	**mm**	**144**	**261**		**351**		**491**		**978**	
	%	**232**	**138**	**15-25**	**109**	**2-5**	**103**	**2-5**	**108**	**2-5**
North West	mm	**203**	369		487		638		1350	
	%	**234**	151	40-60	118	5-15	104	2-5	111	5-10
Northumbrian	mm	**179**	301		381		498		1002	
	%	**269**	157	50-80	119	5-10	107	2-5	116	5-10
Severn Trent	mm	**130**	262		337		441		859	
	%	**235**	150	15-25	115	5-10	105	2-5	112	2-5
Yorkshire	mm	**144**	261		332		437		884	
	%	**232**	141	15-25	106	2-5	97	2-5	106	2-5
Anglian	mm	**85**	168		219		317		628	
	%	**170**	111	2-5	90	2-5	95	2-5	104	2-5
Thames	mm	**89**	171		238		368		693	
	%	**178**	106	2-5	88	2-5	96	2-5	99	2-5
Southern	mm	**75**	143		226		397		763	
	%	**155**	91	2-5	83	2-5	97	2-5	97	2-5
Wessex	mm	**124**	222		309		470		896	
	%	**232**	128	5-10	104	2-5	104	2-5	105	2-5
South West	mm	**219**	336		485		710		1312	
	%	**309**	157	30-40	126	5-15	113	5-10	110	2-5
Welsh	mm	**220**	387		526		719		1487	
	%	**273**	157	30-40	120	5-10	105	2-5	110	2-5
Scotland	**mm**	**147**	**347**		**576**		**819**		**1599**	
	%	**154**	**129**	**20-30**	**121**	**30-50**	**111**	**5-10**	**109**	**5-15**
Highland	mm	**131**	364		677		985		1915	
	%	**122**	121	5-15	123	20-30	115	5-10	110	5-15
North East	mm	**141**	311		435		595		1092	
	%	**184**	142	10-20	118	5-15	110	5-10	106	2-5
Tay	mm	**153**	349		524		725		1346	
	%	**186**	142	10-20	123	10-20	108	2-5	104	2-5
Forth	mm	**156**	309		442		592		1221	
	%	**202**	137	5-15	115	5-10	101	2-5	107	2-5
Tweed	mm	**175**	306		410		564		1164	
	%	**235**	142	10-20	114	5-10	107	2-5	116	10-20
Solway	mm	**185**	363		558		793		1663	
	%	**199**	137	10-20	120	10-20	110	5-10	116	20-30
Clyde	mm	**163**	397		679		940		1865	
	%	**143**	130	10-20	124	15-25	109	2-5	107	5-10
Northern Ireland	**mm**	**131**	**283**		**456**		**621**		**1252**	
	%	**184**	**130**	**5-10**	**122**	**5-10**	**109**	**2-5**	**114**	**10-20**

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

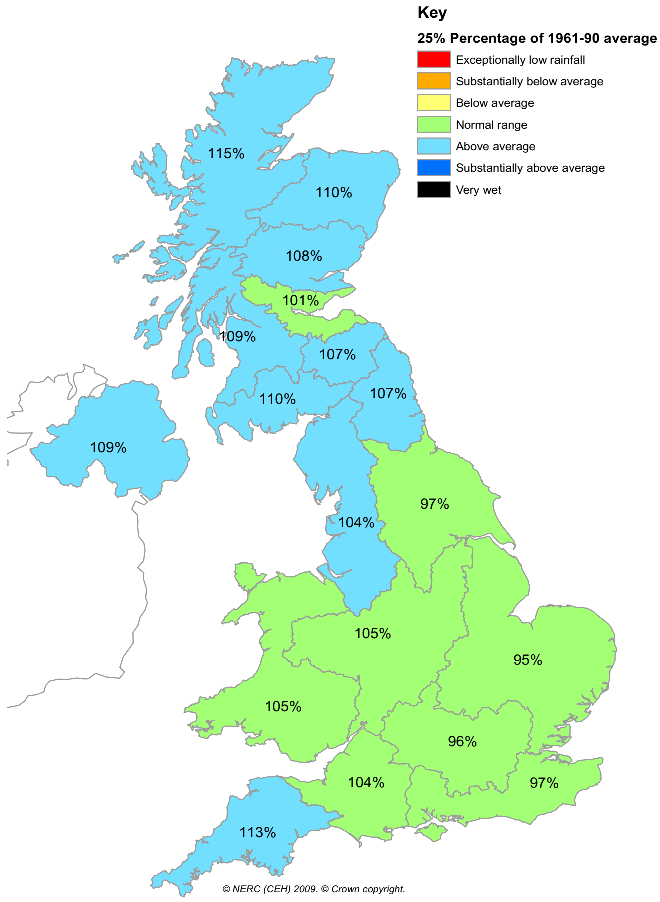
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and derived following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

Rainfall . . . Rainfall . . .

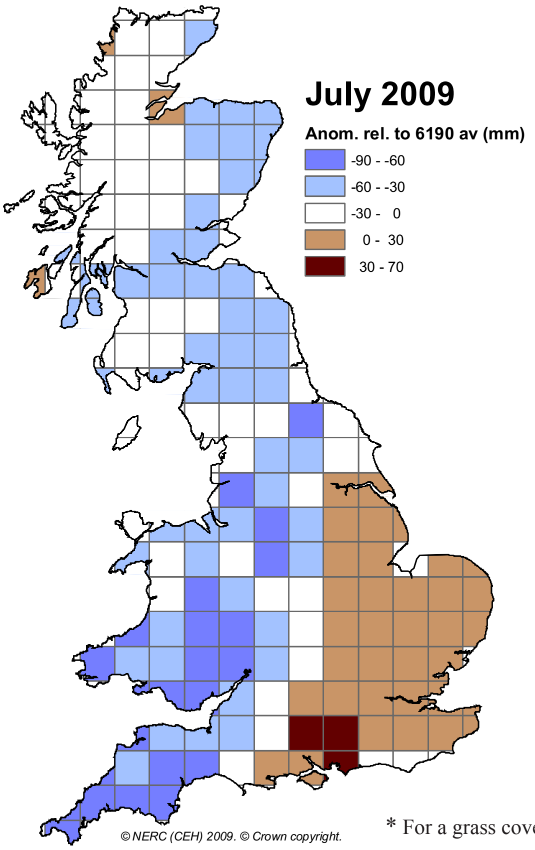
May - July 2009



January - July 2009



MORECS Soil Moisture Deficits *



* For a grass cover

Met Office Summer 2009 forecast

Forecast for the Summer 2009:
Updated 29 July 2009

Temperature

For the UK and much of northern Europe temperatures for the rest of the summer are likely to be near or above average.

Rainfall

For the rest of summer, rainfall is likely to be near or above average over the UK and much of northern Europe.

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

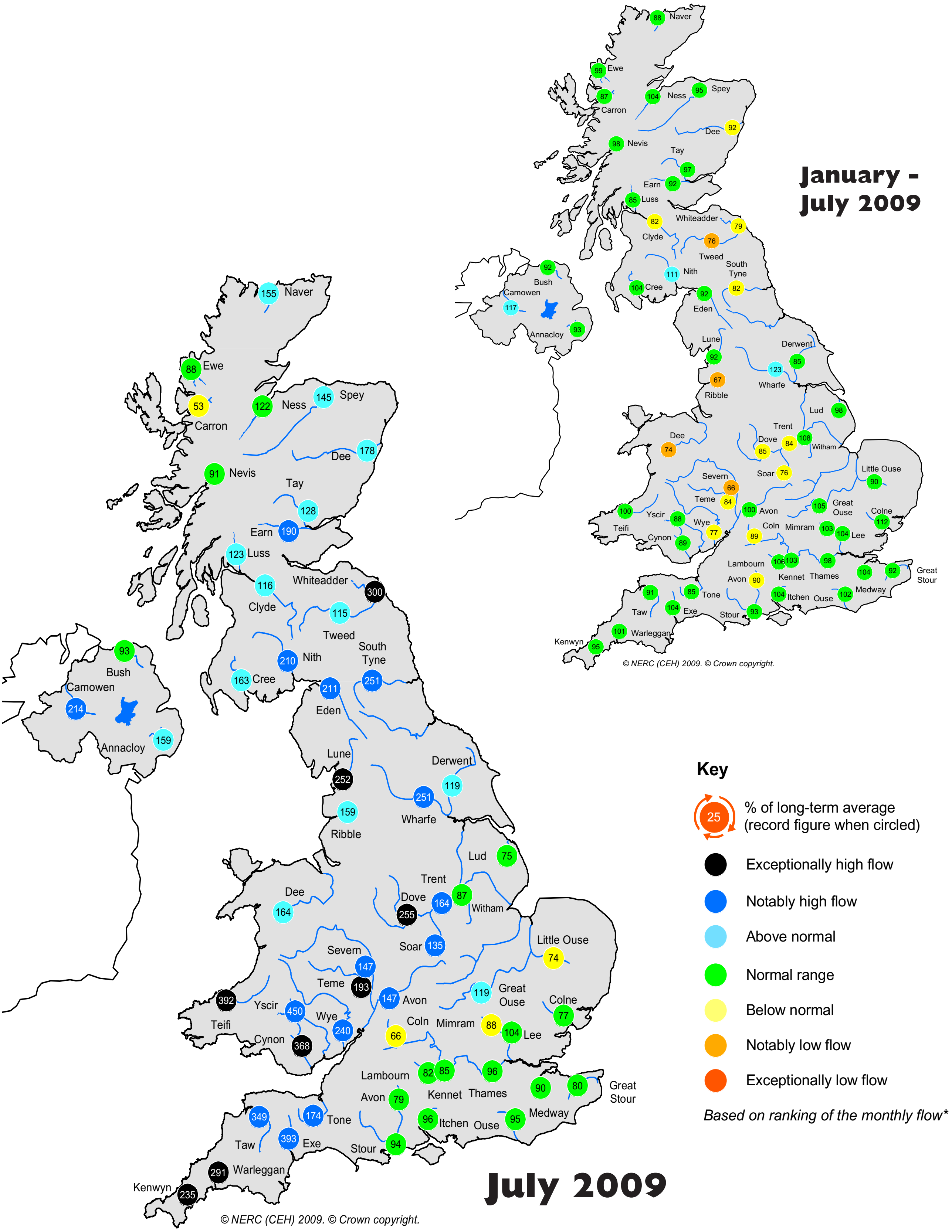
Early indications are that winter precipitation is likely to be near or above average over much of northern Europe. For the UK, Winter 2009/10 is likely to be wetter than last year.

Updates and reviews of the forecast

The forecast for Autumn 2009 will be issued by 11 a.m. on 27 August 2009. The winter forecast will be issued in September For further details please visit:

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

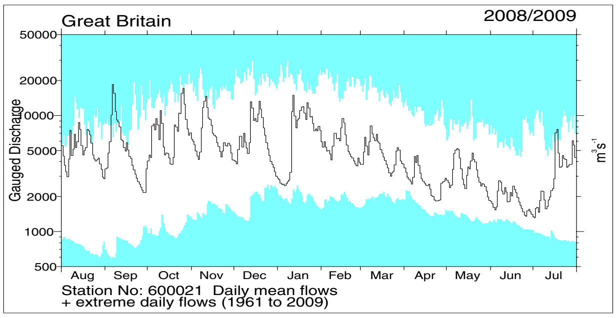
River flow . . . River flow . . .

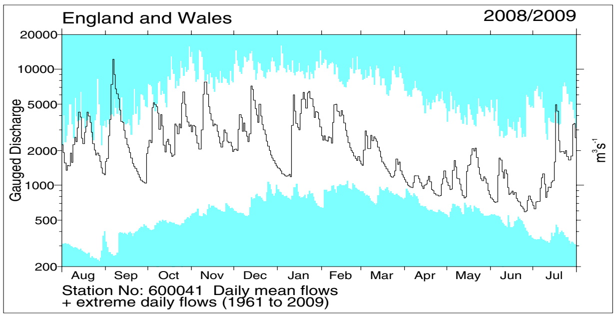


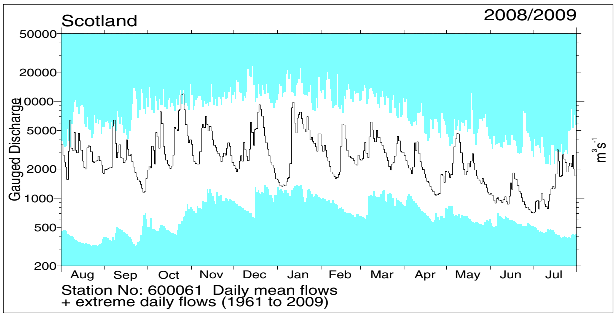
River flows

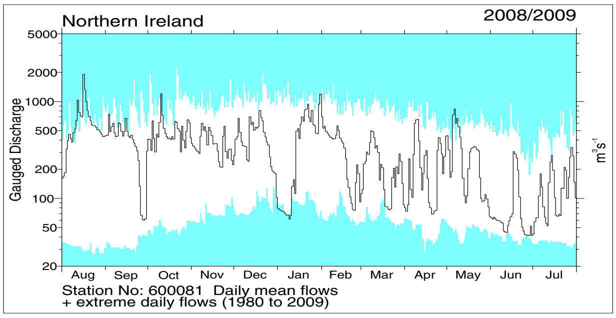
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

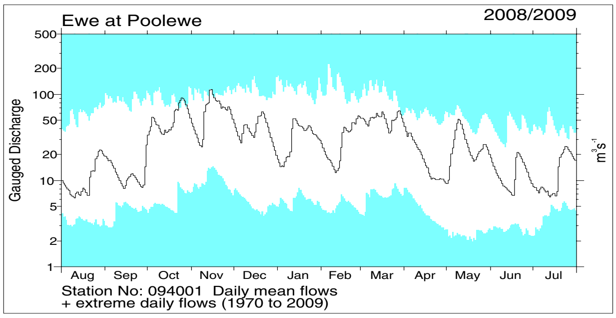
River flow . . . River flow . . .

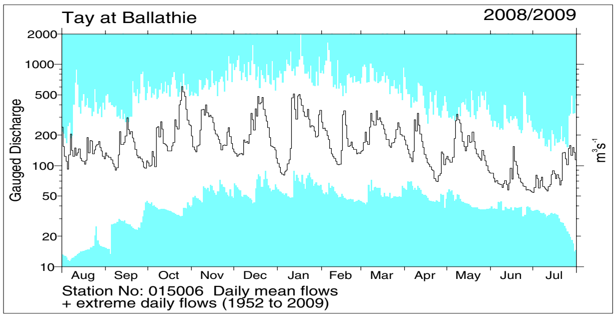


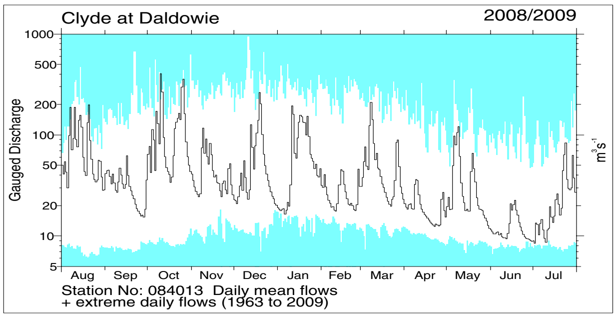


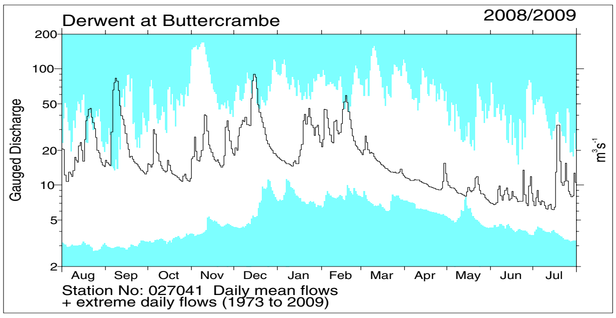


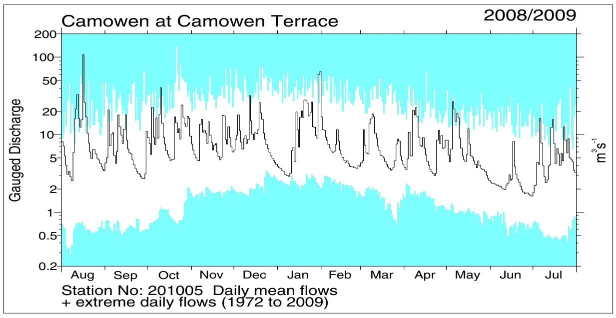


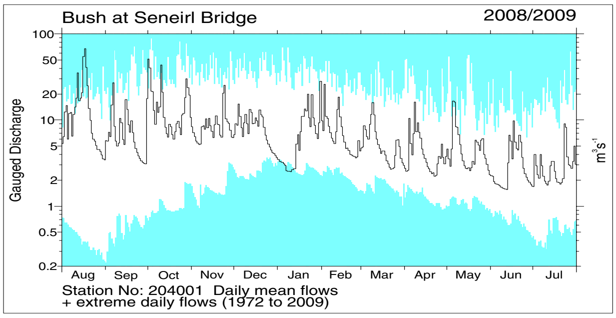








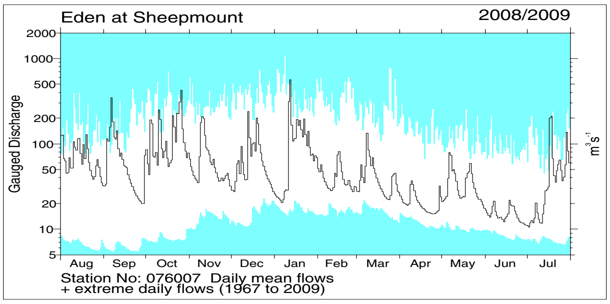


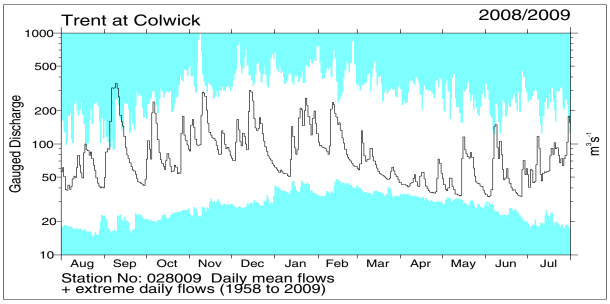


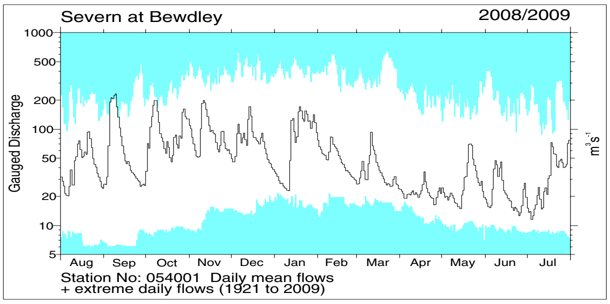
River flow hydrographs

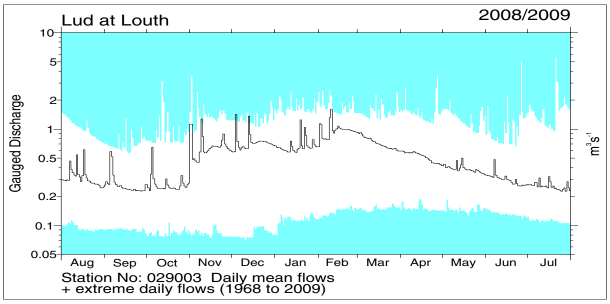
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to August 2008 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

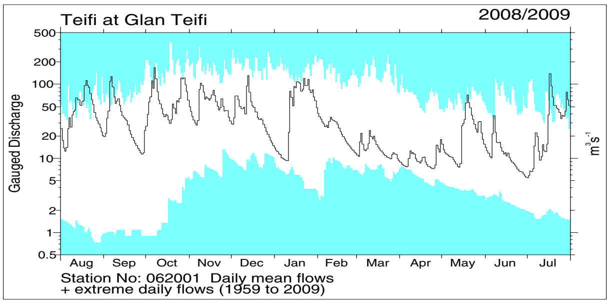
River flow . . . River flow . . .

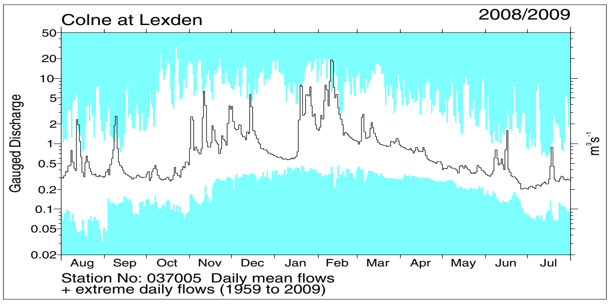


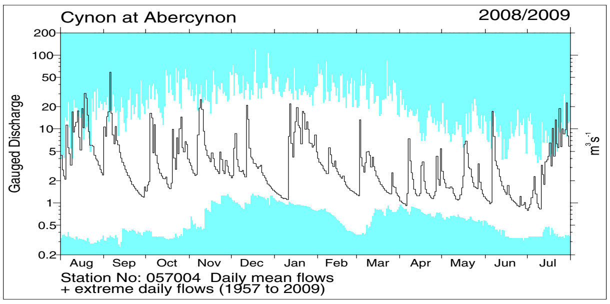


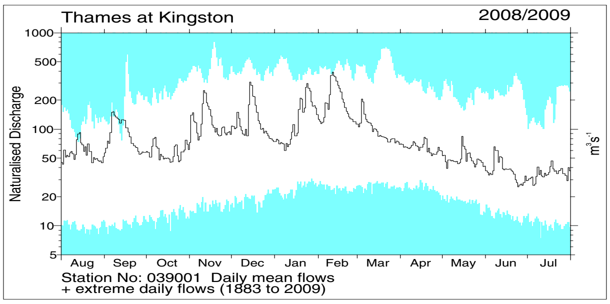


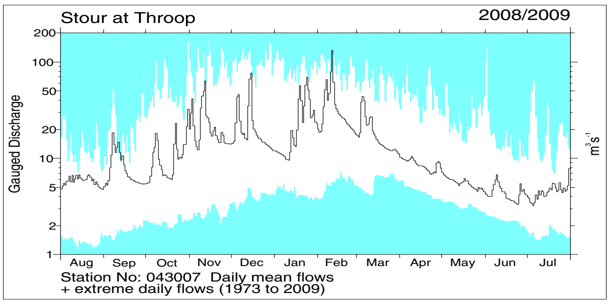


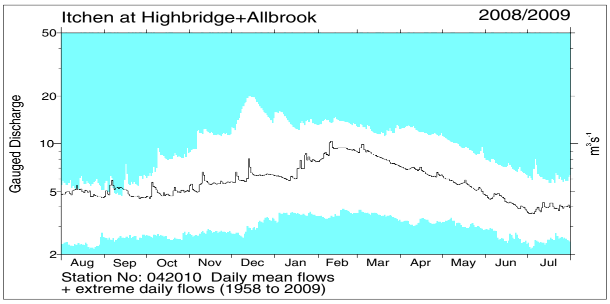












Notable runoff accumulations (a) May - July 2009, (b) August 2008 - July 2009

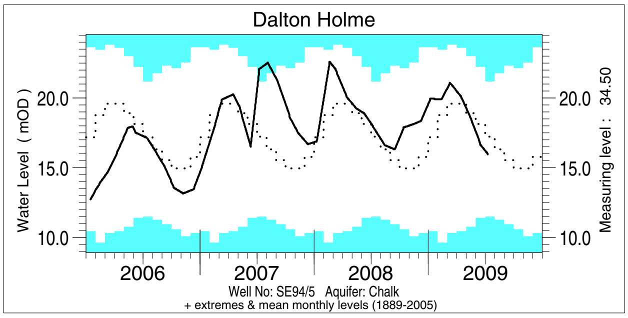
	River	%lta	Rank
a)	Forth	136	23/28
	Wharfe	203	53/54
	Torne	141	32/37
	Coln	64	6/46
	Piddle	76	8/46
	Exe	185	51/54
	Kenwyn	157	39/41
	Yscir	192	37/38

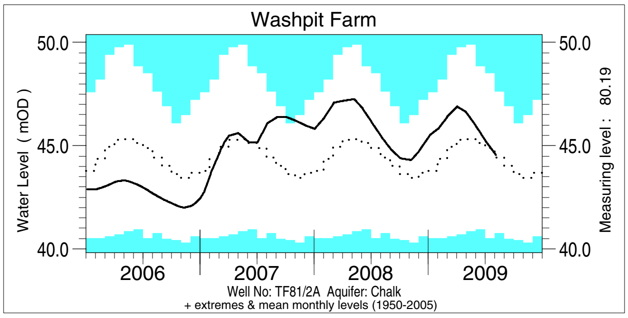
	River	%lta	Rank
a)	Cynon	175	48/51
	Tawe	216	51/51
	Teifi	187	46/49
	Lune	158	45/49
	Nith	162	48/52

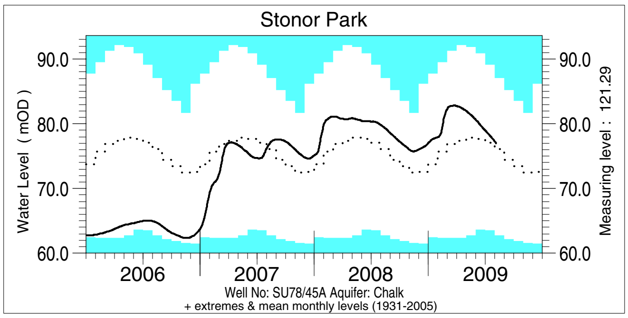
	River	%lta	Rank
b)	Tweed (Norham)	121	45/49
	Wharfe	163	53/53
	Teifi	125	44/48
	Lune	122	44/47
	Camowen	127	34/36
	Mourne	121	27/27
	Annacloy	125	27/29

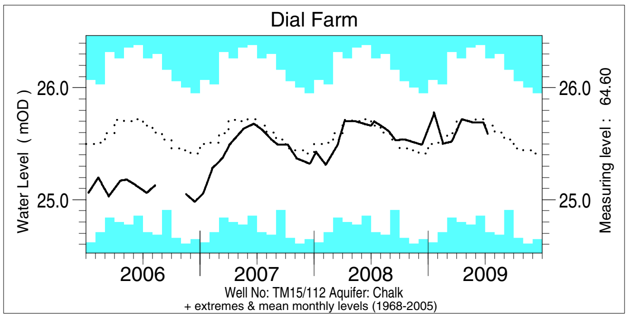
lta = long term average
Rank 1 = lowest on record

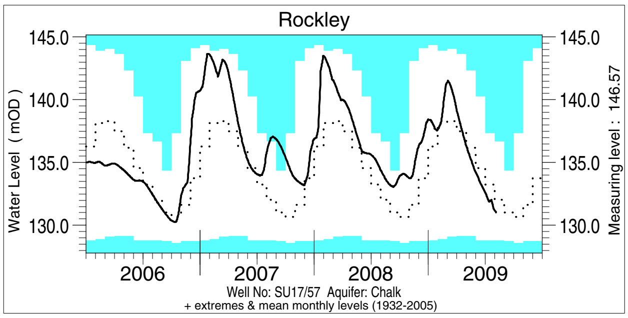
Groundwater . . . Groundwater

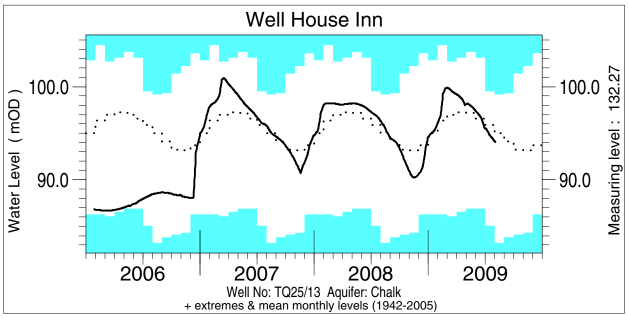


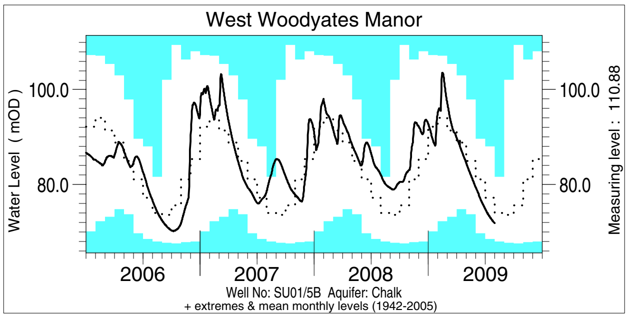


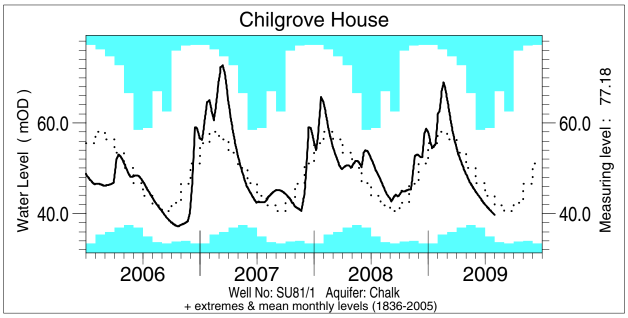


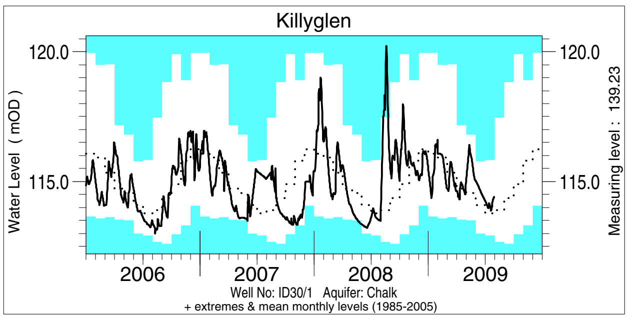


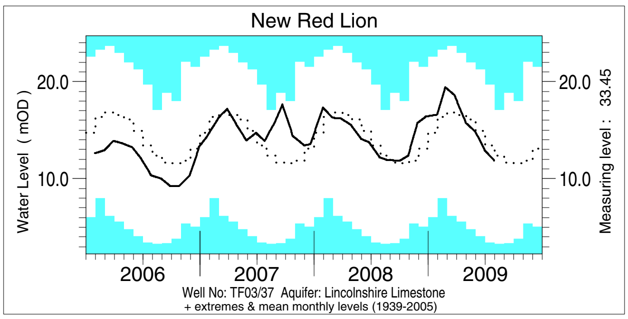






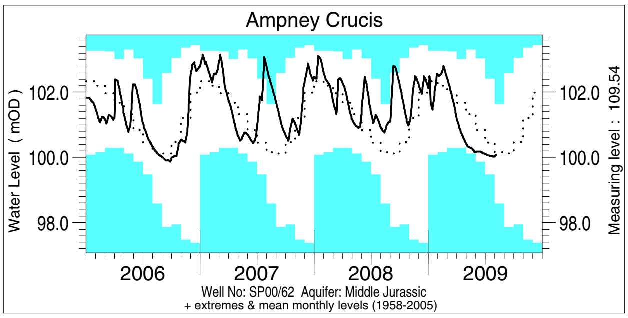


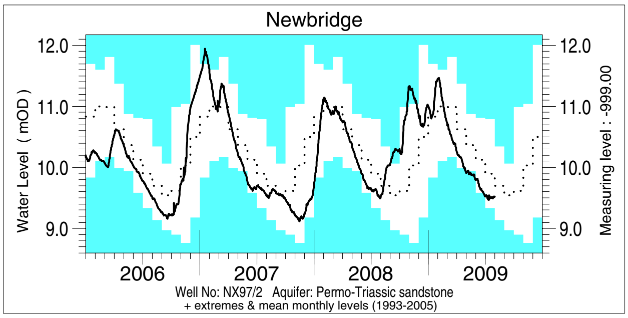


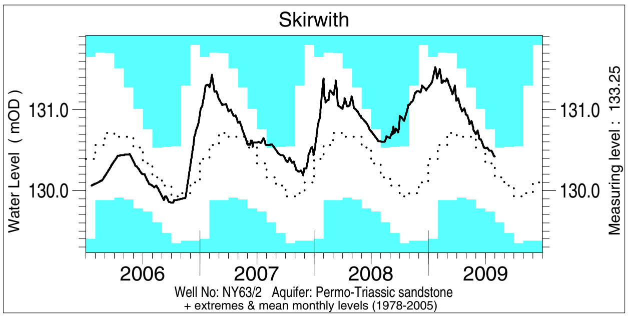


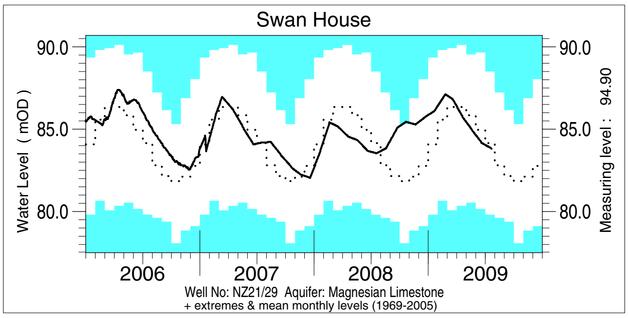
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

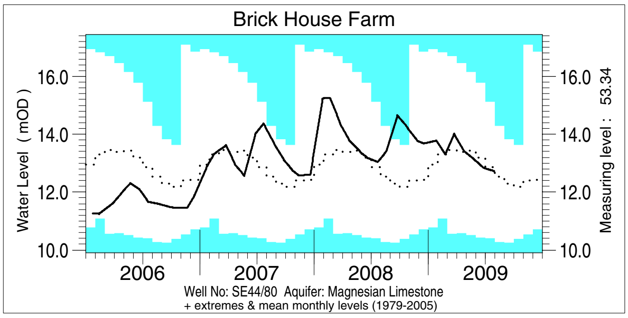
Groundwater . . . Groundwater

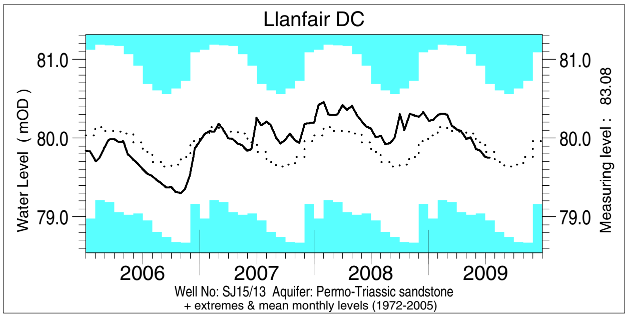


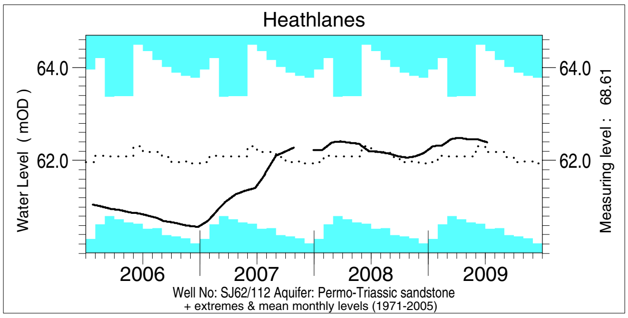


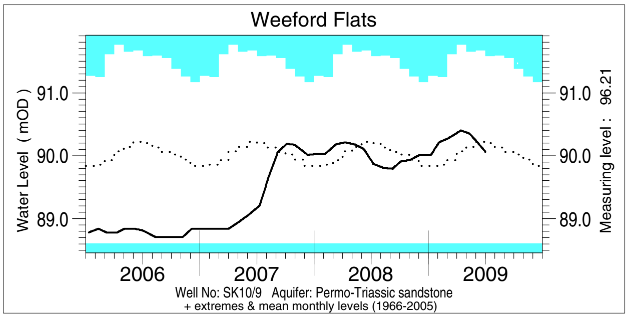


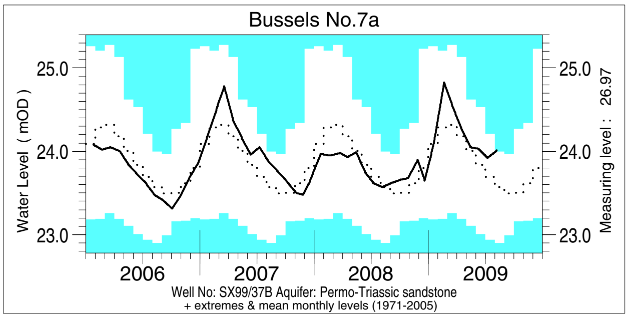


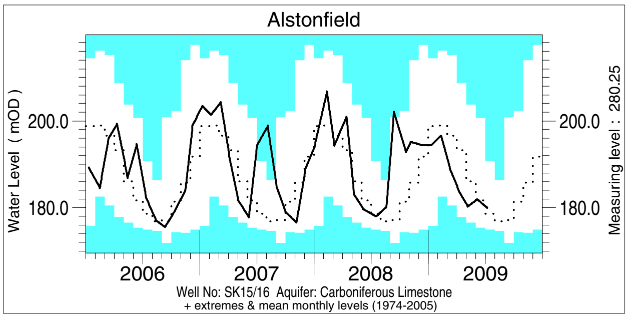










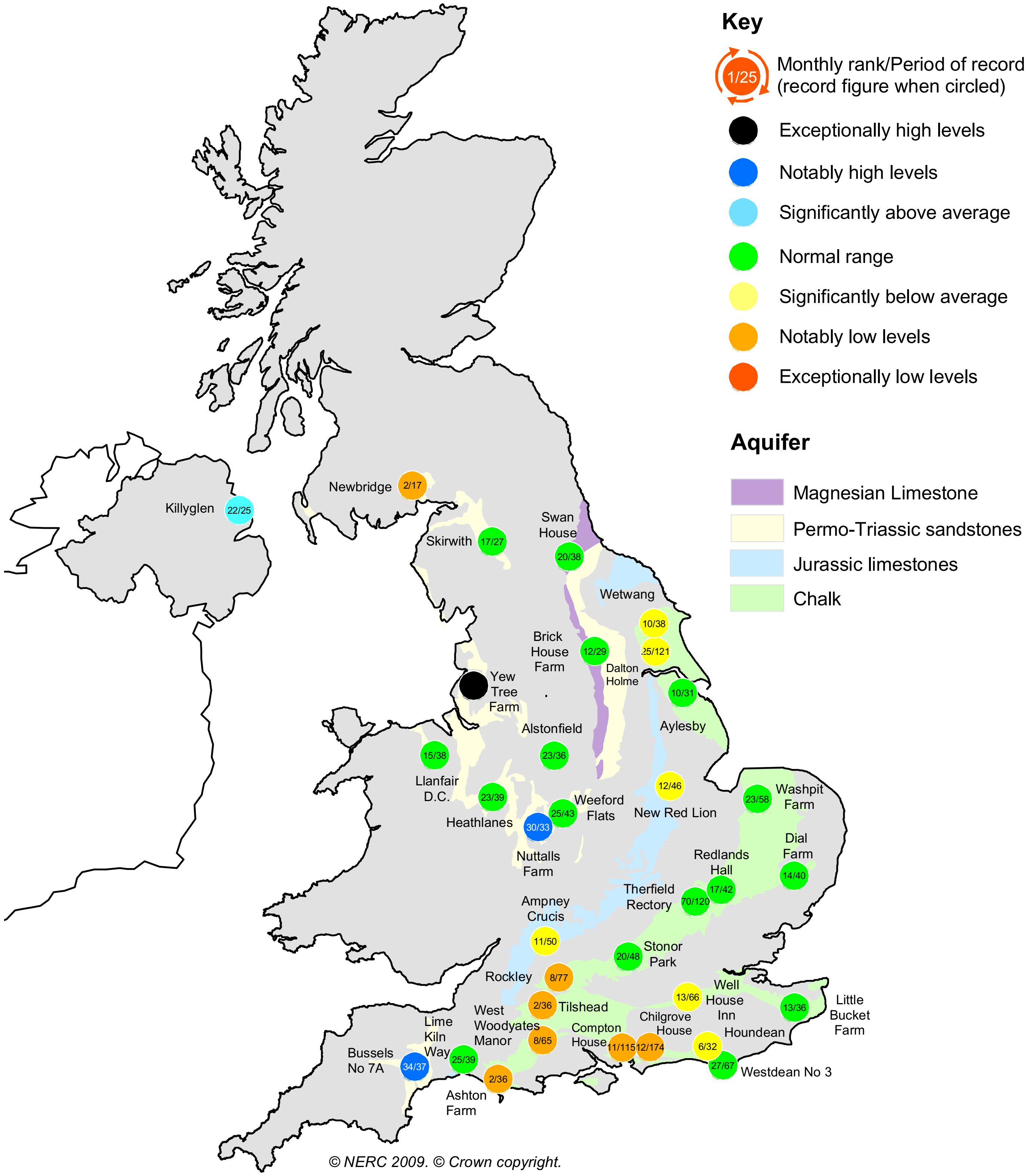


Groundwater levels July / August 2009

Borehole	Level	Date	Jul. av.	Borehole	Level	Date	Jul. av.	Borehole	Level	Date	Jul. av.
Dalton Holme	15.96	10/07	17.23	Chilgrove House	39.70	31/07	43.60	Brick House Farm	12.72	30/07	12.83
Washpit Farm	44.55	04/08	44.90	Killyglen (NI)	114.41	30/07	113.79	Llanfair DC	79.75	15/07	79.76
Stonor Park	77.01	05/08	77.16	New Red Lion	11.85	30/07	13.26	Heathlanes	62.39	08/07	62.13
Dial Farm	25.59	09/07	25.66	Ampney Crucis	100.08	05/08	100.49	Weeford Flats	90.06	02/07	89.88
Rockley	131.04	05/08	133.25	Newbridge	9.52	31/07	9.81	Bussels No.7a	24.01	06/08	23.72
Well House Inn	94.03	03/08	95.77	Skirwith	130.42	31/07	130.29	Alstonfield	179.89	08/07	179.64
West Woodyates	71.84	31/07	77.08	Swan House	83.81	21/07	83.64				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



Groundwater levels - July 2009

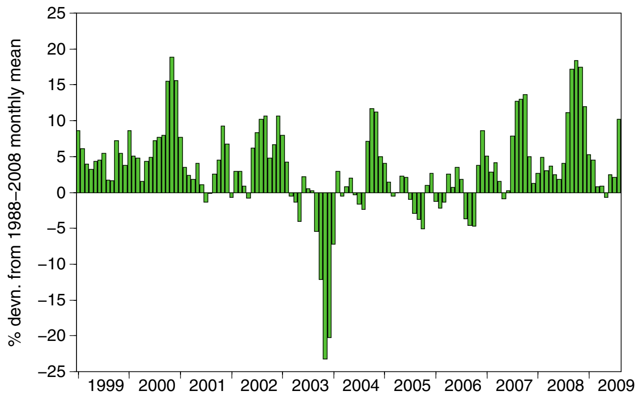
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

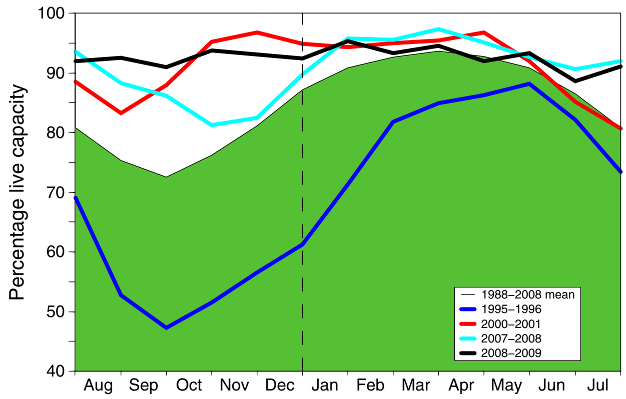
ii. Yew Tree Farm levels are now received quarterly.

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.

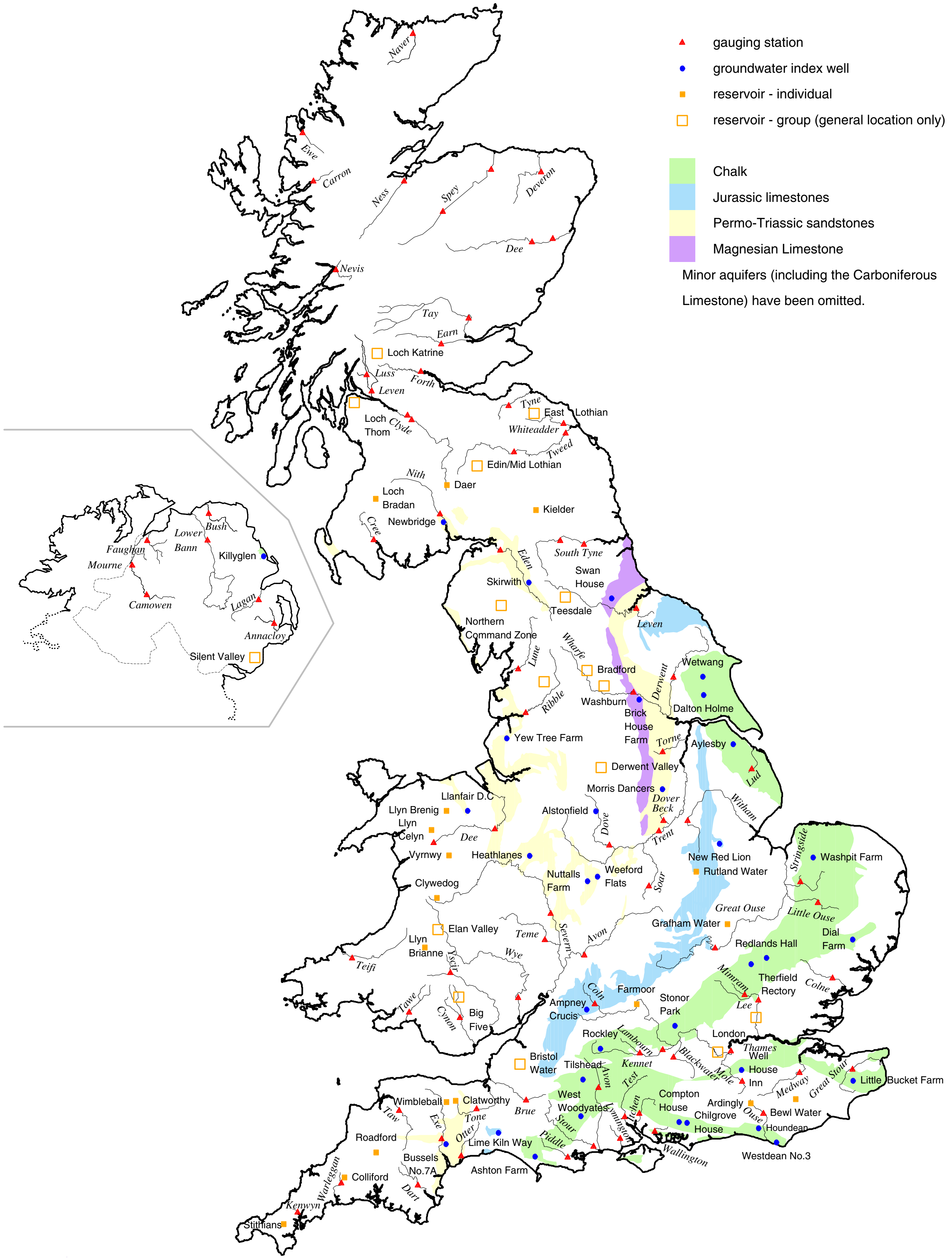
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2009 Jun	Jul	Aug	Aug Anom.	Min Aug	Year* of min	2008 Aug	Diff 09-08
North West	N Command Zone	•	124929	89	78	**82**	19	38	1989	72	10
	Vyrnwy		55146	85	74	**78**	1	56	1996	90	-12
Northumbrian	Teesdale	•	87936	92	84	**96**	25	45	1989	92	4
	Kielder		(199175)	(94)	(91)	**(94)**	6	(66)	1989	(99)	-5
Severn Trent	Clywedog		44922	100	100	**100**	15	57	1989	98	2
	Derwent Valley	•	39525	84	79	**84**	10	43	1996	85	-1
Yorkshire	Washburn	•	22035	88	84	**86**	12	50	1995	91	-5
	Bradford supply	•	41407	87	78	**84**	13	38	1995	95	-11
Anglian	Grafham		(55490)	(94)	(92)	**(90)**	1	(66)	1997	(96)	-6
	Rutland		(116580)	(87)	(85)	**(81)**	-4	(74)	1995	(84)	-3
Thames	London	•	202828	99	95	**95**	9	73	1990	94	1
	Farmoor	•	13822	95	95	**96**	0	84	1990	98	-2
Southern	Bewl		28170	84	76	**66**	-10	45	1990	88	-22
	Ardingly		4685	98	86	**83**	-4	65	2005	94	-11
Wessex	Clatworthy		5364	78	75	**92**	19	43	1992	99	-7
	Bristol WW	•	(38666)	(85)	(77)	**(86)**	11	(53)	1990	(87)	-1
South West	Colliford		28540	100	97	**95**	18	47	1997	98	-3
	Roadford		34500	91	89	**92**	13	46	1996	93	-1
	Wimbleball		21320	90	89	**94**	16	53	1992	97	-3
	Stithians		5205	94	85	**83**	14	39	1990	71	12
Welsh	Celyn and Brenig	•	131155	100	97	**95**	7	65	1989	96	-1
	Brianne		62140	99	96	**100**	11	67	1995	98	2
	Big Five	•	69762	90	85	**95**	19	41	1989	95	0
	Elan Valley	•	99106	99	95	**100**	17	63	1989	95	5
Scotland(E)	Edinburgh/Mid Lothian	•	97639	97	93	**89**	8	51	1998	90	-1
	East Lothian	•	10206	97	97	**100**	12	72	1992	98	2
Scotland(W)	Loch Katrine	•	111363	98	84	**82**	9	53	2000	63	19
	Daer		22412	99	93	**90**	11	58	1994	90	0
	Loch Thom	•	11840	96	95	**95**	14	59	2000	80	15
Northern Ireland	Total+	•	61600	95	86	**93**	17	54	1995	68	25
	Silent Valley	•	20634	91	85	**93**	24	42	2000	71	22

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

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2008 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

Location map . . . Location map



National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP) was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology Wallingford (formerly the Institute of Hydrology - IH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

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

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

Rainfall

Most rainfall data are provided by the Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of the Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS*. Recent figures have been produced by the Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national and regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available by the Met Office in 2004; these have been adopted by the NHMP. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.
The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

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

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

Subscription

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

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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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