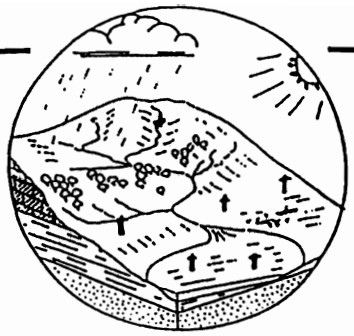
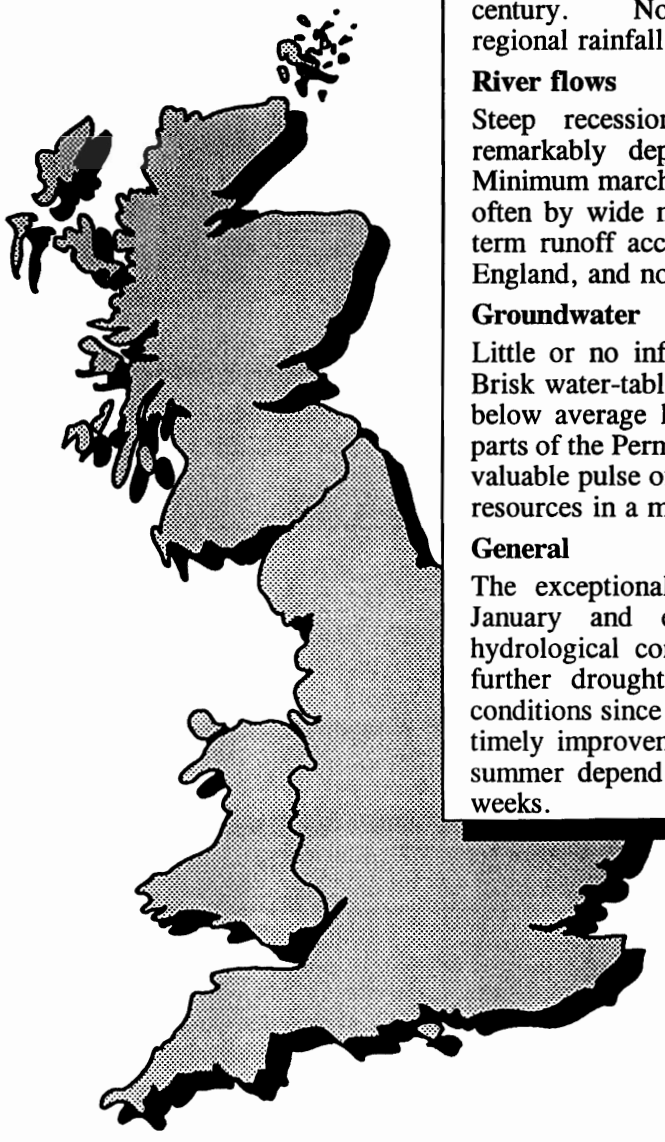
Hydrological Summary for Great Britain





MARCH 1993

Rainfall

Close to average for Scotland but only around 40% for England and Wales where, apart from the month-end exceptionally dry conditions prevailed. For E & W the combined Feb/March rainfall total was the second lowest this century. Nonethless, winter half-year and 12-month regional rainfall totals are within the normal range.

River flows

Steep recessions continued from February producing remarkably depressed runoff rates late in the month. Minimum march runoff totals were eclipsed in many rivers, often by wide margins in impermeable catchments. Long term runoff accumulations remain notably low in lowland England, and notably high in western Scotland.

Groundwater

Little or no infiltration before the 29-31st in most areas. Brisk water-table declines throughout the month resulted in below average levels in the Chalk and depressed levels in parts of the Permo-Triassic sandstones. However, the recent valuable pulse of recharge should leave overall groundwater resources in a much healthier state than a year ago.

General

The exceptionally dry conditions beginning around late January and extending over ten weeks transformed hydrological conditions and signalled the likelihood of a further drought episode. However, the very unsettled conditions since late March have produced a substantial and timely improvement in water resources. Prospects for the summer depend in large part on rainfall over the next six weeks.

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HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - March 1993

Data for this report have been provided principally by the regional divisions of the National Rivers Authority in England and Wales, the River Purification Boards in Scotland and by the Meteorological Office. Reservoir contents information has been supplied by the Water Services Companies, the NRA or, in Scotland, the Lothians Regional Council. The most recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a proportion of the river flow data is of a provisional nature.

A map (Figure 3) is provided to assist in the location of the principal monitoring sites.

Rainfall

March was another very mild month and sunshine hours were generally above average. With the exception of the month-end, March was exceptionally dry in most parts of England and Wales. As in February, anticyclonic conditions were dominant and few active frontal systems crossed the country. The very meagre late winter/early spring rainfall in most of southern Britain, at a crucial time, produced a marked deterioration in the water resources outlook following the flooding and saturated soil conditions which characterised January.

A considerable proportion of Scotland registered close to or above average rainfall for March but in southern Britain rainfall totals were notably low - without the wet spell on the 30/31st, March would have been remarkably dry. The monthly rainfall total for England and Wales - 27mm - was appreciably below half of the 1941-70 average and was the second lowest for March (after 1990) in the last 20 years. The (provisional) combined February/March rainfall total (45mm) is even more exceptional, ranking second driest this century. Considering any start month, there have only been three or four drier two-month pairings since 1900. Relative to the long term average, the February/March rainfall deficiencies were substantial in all areas, rainfall was only around a quarter of the long term average in most NRA regions - appreciably less in the Severn-Trent and Welsh regions. In terms of actual amounts, rainfall was especially meagre in central and southern England and parts of Wales. Lengthy sequences of dry days were commonplace. In some lowland areas rainfall was recorded on less than five days in the 60-day period ending on the 29th March, by contrast around two-thirds of the preceding sixty days had been wet. The 52-day rainfall total for the Institute of Hydrology's Met. station for the period ending on March 20th was less than 5mm - the longest timespan necessary to achieve this threshold in a 32-year record.

Accumulated rainfall totals over the medium and long term (Table 2) reflect the recent dry spell but deficiencies remain moderate compared to those reported in 1991 and early 1992. With the exception of western Scotland, which added another wet winter to a notable cluster, winter half-year regional rainfall totals were relatively close to the 1941-70 average, and, generally, regional rainfall totals in the 12-month timeframe are a little above average. Significant long term deficiencies can still be identified in eastern and southern England. In water resources terms, however, the magnitude of these deficiencies is rather less influential than the timing of the recent dry spell which coincides with what is, on average, the peak period for runoff and recharge. As a result the resources outlook in late-March was delicately poised. With the return of the Westerlies - and substantial rainfall in all regions over the period commencing March 29th (some areas had the equivalent of around two-months of spring rainfall over the following fortnight) the mounting concern for water resources prospects has, in large part, been allayed. The balance between rainfall, evaporation rates and soil moisture deficits over the next six weeks or so will provide a firmer basis on which to assess the prospects for the summer and autumn.

Runoff

Throughout the great majority of the month, March saw a continuation of the remarkably steep recessions which followed widespread spate conditions in January. Although 1990 provides a recent precedent in the English lowlands, the dramatic decline in river flows in many impervious catchments has few modern parallels and produced exceptionally low spring flows over much of Britain.

The transformation in hydrological conditions - the latest in an extraordinary sequence - over the eight weeks from late January is well illustrated on the South Tyne: the January runoff total ranks as the second highest in a 30-year record, March established a new minimum for the month. Gauging stations registering unprecedented mean flows for March showed a very wide distribution. New March minimum runoff totals were established in almost half the England and Wales catchments for which data are furnished for the Hydrological Summaries. Notable examples include Colwick (on the Trent) and Bewdley where the Severn recorded its lowest March runoff in a series from 1921. Where flow records are relatively short, previous minima were often eclipsed by wide margins. The March runoff for Knightsford Bridge on the River Teme, for example, was less than half of the pre-1993 minimum, a distinction shared with the Umberleigh (Taw) and Pontaryscir (Yscir) gauging stations.

The importance of groundwater in sustaining lowland river flows was clearly evident in many chalk catchments - flows on the Itchen and the Mimram, for example, were well within the normal range. However, where baseflows make a lesser contribution, runoff rates were widely depressed, typically less than 40% of average. In many spring-fed lowland rivers the March 1993 mean flows rank as notable in relation to the pre-1989 record but their significance declines when flows over the last four years are also considered. Despite a number of important wet interludes, long term accumulations in many catchments remain amongst the lowest on record; by contrast runoff totals for a number of Scottish rivers, especially those draining from the Highlands, remain outstandingly high.

Very unsettled conditions beginning around the end of March generally produced a steep recovery in river flows. In some lowland catchments the recovery was delayed by late-March soil moisture deficits (SMDs) which had reached 40 mm or more in eastern England. A particularly rapid increase in runoff rates was reported for the River Cree (Dumfries and Galloway) where the peak flow, on the 30th, closely approached the maximum in a 30-year record. Following 100 mm of rainfall in the headwaters, the Tay (at Ballathie) again recorded a peak flow (on the 30th) in excess of the mean annual flood discharge. Over the following ten days many rivers throughout the rest of Britain also experienced spate, or near spate, conditions.

Reservoir contents normally remain close to capacity throughout most of March. This year some notable depletions were reported. For example a reduction of around 20% was recorded for the Derwent Valley Group and at Taf Fawr (one of the 'Big Five' in South Wales) stocks fell to about 60% by late March. The resources outlook again appeared fragile. However, healthy replenishment over the ensuing period improved the outlook substantially in most areas - Taf Fawr, for instance, recovering to over 90% of capacity. In the lowlands, early-April stocks were appreciably above the corresponding figure for 1992.

Groundwater

The wet summer and autumn of 1992 ensured an early onset of recharge to most aquifers and, potentially, the recharge season was much longer than has been typical in recent winters. Very substantial recharge over the December-January period (in most areas) has, however, been succeeded by 8-10 weeks of very modest aquifer replenishment. The steady rise in SMDs through most of March signalled an increasing likelihood of a further year characterised by extended groundwater level

recessions. Fortunately, the late but significant pulse of recharge around the Easter period has moderated, and in some areas reversed, the steep spring decline in water-tables.

At those sites where the response of groundwater levels to rainfall is substantially delayed, such as the deep Chalk wells at Washpit Farm and Therfield Rectory, groundwater levels towards the end of March were still rising. Elsewhere, the lack of rainfall through most of February and March led to generally falling water-tables.

Water-tables in Norfolk, south-west England, on the east coast north of the Wash, and in parts of the Midland Belt (at Stone and Llanfair DC), remain below the seasonal mean. The site at Llanfair DC is still close to the seasonal minimum and Alstonfield (Carboniferous Limestone) registered its lowest March level in a 20-year record. In southern England, water-tables were generally within the normal range towards the end of the month. Although spatial variation is considerable, groundwater levels in the Permo-Triassic sandstones were generally more depressed, at the end of March, than those in the Chalk which stood well above corresponding levels in 1992 over wide areas.

The heavy rainfall of late March and early April is likely to provide a useful boost to groundwater resources before the final onset of the summer recession. At Ampney Crucis in the Oolitic Limestone (which responds rapidly to rainfall) a significant upturn was registered in the first week of April and the wider benefit of the recent rainfall should be evident when next month's levels are collated. As is often the case in the spring, groundwater levels may change rapidly over periods of a few weeks. (Note: Therefore when interpreting the hydrographs featured in Figure 2 reference should be made to the date of the latest level measurement - given in Table 5).

In those parts of England most severely affected by drought conditions over the last four years, groundwater resources in the late spring will probably be in a healthier state, for the time of year, than at any time since 1989. Nonetheless, some areas of anxiety can still be identified. Levels remain notably depressed in parts of the Triassic sandstones of the Midlands, and possibly in the Magnesium Limestone and the Chalk of north Yorkshire, where the water-table appears to be below to well below the seasonal mean. The failure of the water level at Llanfair DC site to rise much above the 1992 equivalent is also disturbing; in this district, the recession of 1993 may resemble that of 1992 although starting from a rather higher level.

Institute of Hydrology/British Geological Survey
14 April 1993

TABLE 1 1992/93 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Mar 1992	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan 1993	Feb	Mar
England and	mm	85	75	49	45	87	126	103	90	135	75	98	18	27
Wales	%	144	129	73	74	119	140	124	108	139	84	114	28	46
NRA REGIONS														
North West	mm	142	89	62	31	72	137	114	128	163	107	135	22	34
	%	197	116	76	37	70	110	93	109	135	89	120	28	47
Northumbria	mm	107	103	31	19	61	104	108	84	99	69	78	17	24
	%	206	187	48	31	79	103	137	112	105	92	98	26	46
Severn-Trent	mm	67	50	59	55	87	117	72	73	111	60	77	10	16
	%	129	96	92	98	134	144	107	113	141	85	112	19	31
Yorkshire	mm	96	66	34	33	81	94	98	80	104	67	82	22	17
	%	170	118	56	57	116	104	136	115	116	90	107	34	32
Anglian	mm	63	43	48	34	89	82	92	72	86	40	54	17	17
	%	158	108	102	69	156	128	176	138	140	75	105	40	42
Thames	mm	52	65	60	39	77	107	89	76	112	57	82	6	24
	%	113	141	107	75	128	153	144	118	153	86	132	13	53
Southern	mm	59	84	30	26	75	105	73	81	132	70	85	9	31
	%	113	175	55	52	127	144	102	103	141	87	112	16	60
Wessex	mm	57	81	24	49	64	127	94	50	149	82	120	7	40
	%	98	150	35	91	103	155	119	61	153	91	143	12	69
South West	mm%	75	100	31	23	83	171	100	96	197	104	152	22	35
		89	141	37	35	99	169	96	85	147	77	118	25	42
Welsh	mm	129	91	80	48	93	212	112	100	196	124	168	23	31
	%	148	107	88	59	98	178	89	77	137	85	123	24	35
Scotland	mm	208	123	80	52	103	217	187	148	196	141	291	70	91
	%	226	137	88	57	92	168	136	99	138	90	212	67	98
RIVER PURIFICATION BOARDS														
Highland	mm	248	138	105	46	97	250	177	144	241	190	407	86	107
	%	218	121	102	42	76	169	112	78	143	101	248	65	94
North-East	mm	113	68	57	50	48	128	113	107	97	90	200	41	56
	%	182	111	74	71	52	120	130	110	94	88	220	55	90
Tay	mm	172	90	57	30	78	197	152	92	165	106	324	32	83
	%	210	120	60	36	76	167	132	76	153	79	274	35	102
Forth	mm	164	76	45	25	67	174	156	80	167	81	236	18	76
	%	238	112	54	33	68	150	144	75	155	74	238	24	111
Tweed	mm	138	98	52	27	60	151	126	80	123	75	139	13	42
	%	238	161	68	40	67	132	135	91	118	83	149	18	73
Solway	mm	206	144	66	30	99	214	166	114	190	119	200	22	87
	%	226	164	72	33	90	165	110	79	131	79	143	23	95
Clyde	mm	267	144	93	41	123	270	195	135	272	142	332	42	137
	%	254	140	96	40	95	190	111	74	163	76	206	37	130

Note: The most recent monthly rainfall figures correspond to the MORECS areal assessments derived by the Meteorological Office; the provisional figures for England and Wales and for Scotland are derived using a different raingauge network. The regional areal rainfall figures are regularly updated (normally one or two months in arrears) using figures derived from a far denser raingauge network.

TABLE 2 RAINFALL FOR SELECTED PERIODS WITH CORRESPONDING RETURN PERIOD ESTIMATES

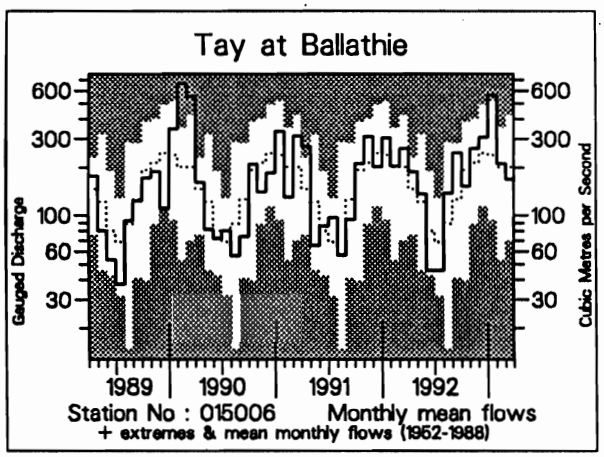
		Oct92-Mar93		Apr92-Mar93		Mar90-Mar93		Aug88-Mar93	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm%	443		926		2459		3881	
	LTA	93	2-5	102	2-5	88	15-25	90	15-25
NRA REGIONS									
North West	mm%	589		1094		3370		5396	
	LTA	94	2-5	90	2-5	91	5-10	94	5-10
Northumbria	mm	372		798		2407		3623	
	% LTA	84	5	91	2-5	90	10-15	88	25-50
Severn-Trent	mm	347		787		2061		3250	
	% LTA	89	2-5	102	2-5	87	10-20	90	10-20
Yorkshire	mm	371		777		2177		3403	
	% LTA	87	2-5	93	2-5	85	20-40	87	30-60
Anglian	mm	285		672		1612		2469	
	% LTA	95	2-5	110	2-5	86	15-25	86	30-60
Thames	mm	357		795		1849		2909	
	% LTA	100	<2	113	5	86	15-25	88	15-25
Southern	mm	409		801		2056		3207	
	% LTA	93	2-5	101	2-5	85	20-30	85	40-60
Wessex	mm	447		885		2243		3620	
	% LTA	95	2-5	102	2-5	84	20-40	88	15-25
South West	mm	607		1115		3137		5142	
	% LTA	89	2-5	93	2-5	86	20-30	91	10-15
Welsh	mm	641		1277		3627		5884	
	% LTA	87	2-5	96	2-5	89	10-20	93	5-10
Scotland	mm	937		1698		5055		7835	
	% LTA	120	10-15	119	20-35	115	80-140	116	>200
RIVER PURIFICATION BOARDS									
Highland	mm	1175		1987		6244		9780	
	% LTA	122	10-20	115	5-15	118	>200	120	>>200
North-East	mm	590		1054		3019		4470	
	% LTA	111	2-5	103	2-5	96	2-5	93	5-15
Tay	mm	803		1406		4073		6437	
	% LTA	120	5-10	112	5-10	106	2-5	109	10-20
Forth	mm	659		1201		3661		5698	
	% LTA	116	5-10	107	2-5	107	5-10	108	10-20
Tweed	mm	471		985		3003		4524	
	% LTA	94	2-5	98	2-5	98	2-5	96	2-5
Solway	mm	731		1449		4459		7038	
	% LTA	96	2-5	102	2-5	102	2-5	104	2-5
Clyde	mm	1060		1926		6057		9427	
	% LTA	116	5-10	116	5-15	119	>200	119	>>200

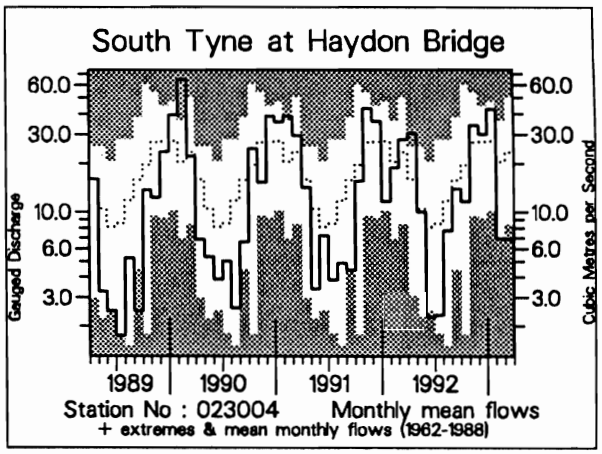
Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods underlined.

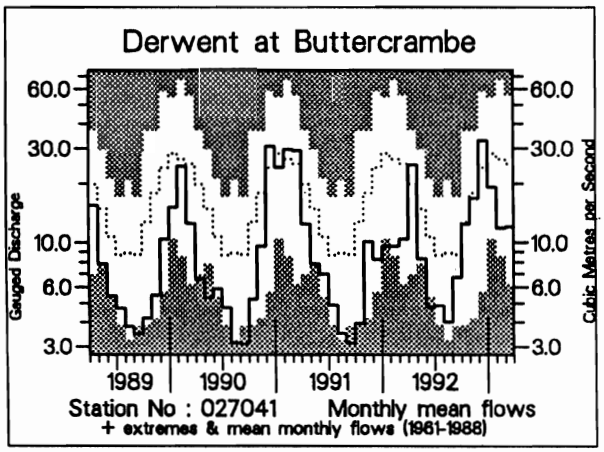
Note: The long-term accumulated rainfall totals have been recomputed following the discovery of an error in the December 1992 report. As a result the long-term accumulations presented in Table 2 are slightly higher than those featured in recent months.

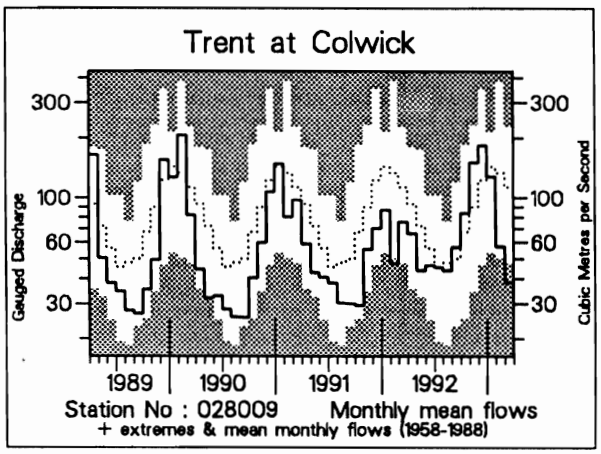
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

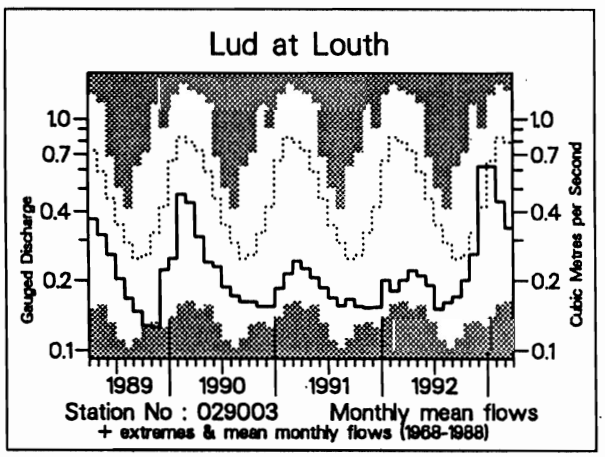
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

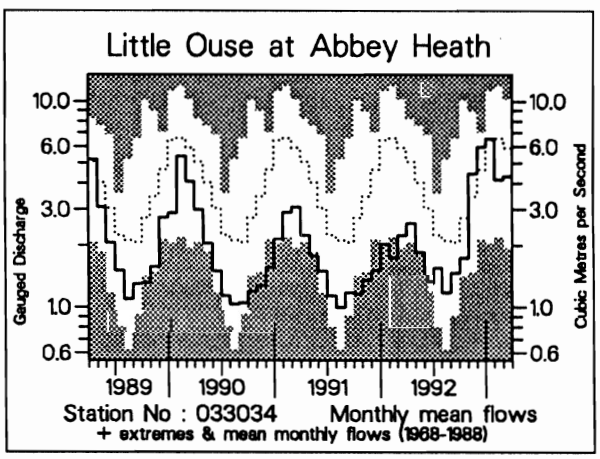


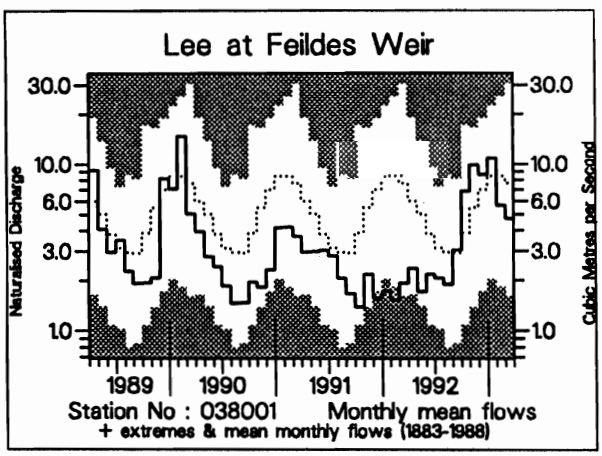


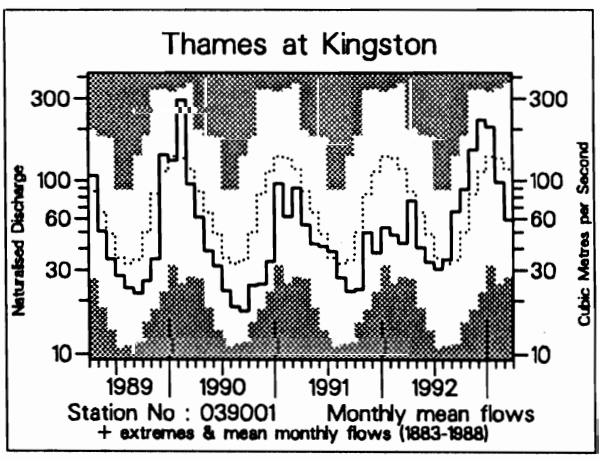


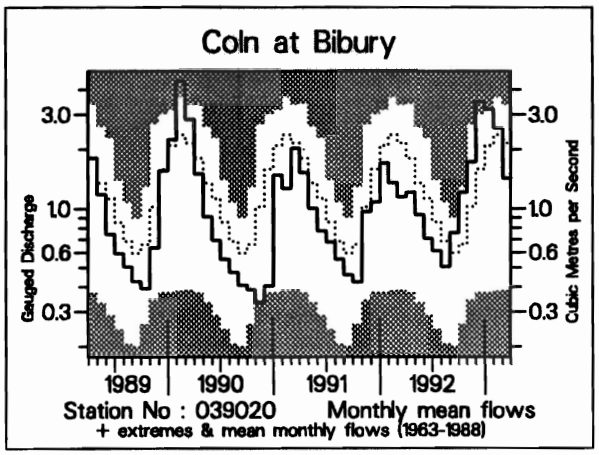


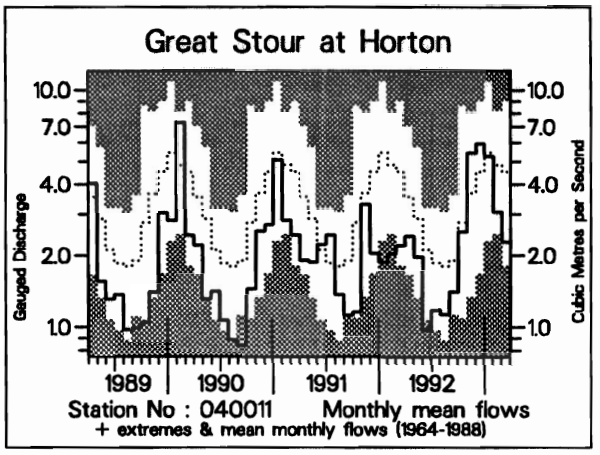


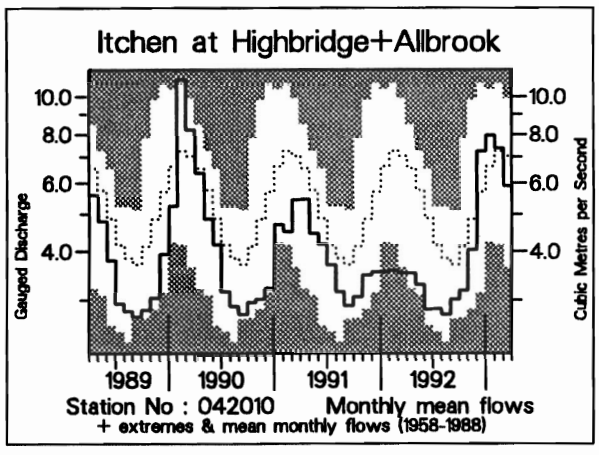


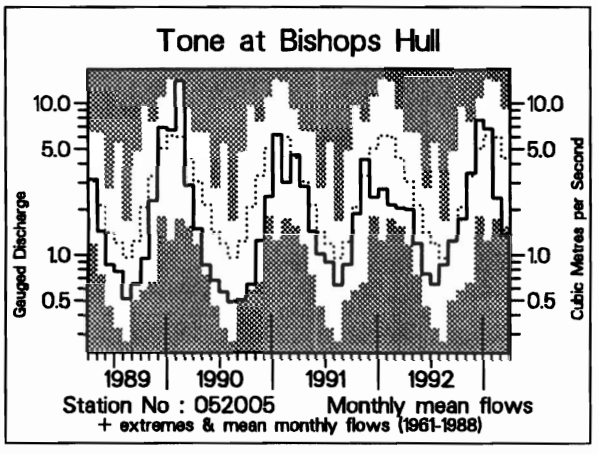


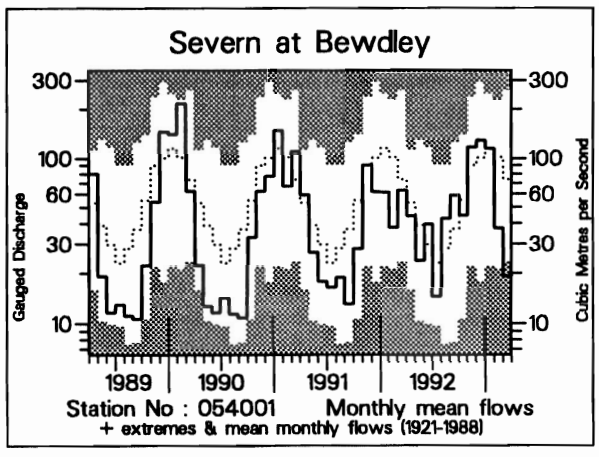


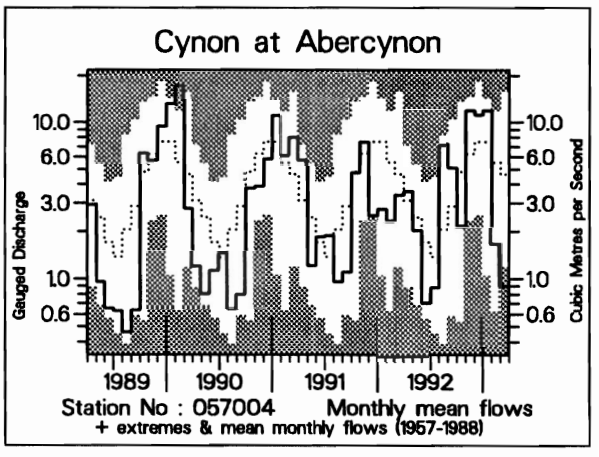

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1989
1990
1991
1992
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

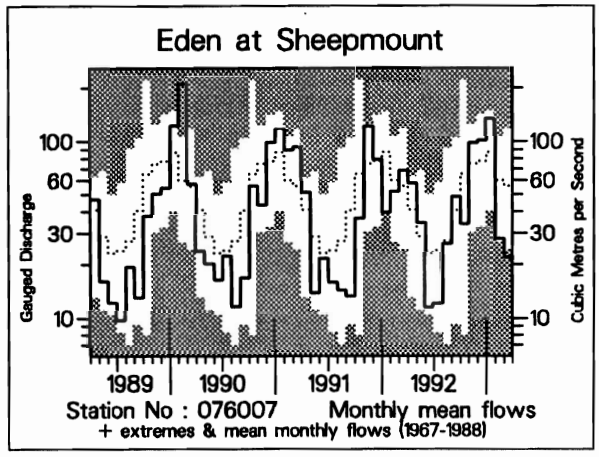

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1989
1990
1991
1992
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10.0
8.0
6.0
4.0
1989
1990
1991
1992
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1988)


Tone at Bishops Hull
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1989
1990
1991
1992
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1988)


Severn at Bewdley
Gauged Discharge
Cubic Metres per Second
300
100
60
30
10
1989
1990
1991
1992
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1988)


Cynon at Abercynon
Gauged Discharge
Cubic Metres per Second
10.0
6.0
3.0
1.0
0.6
1989
1990
1991
1992
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1988)


Eden at Sheepmount
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1989
1990
1991
1992
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1988)

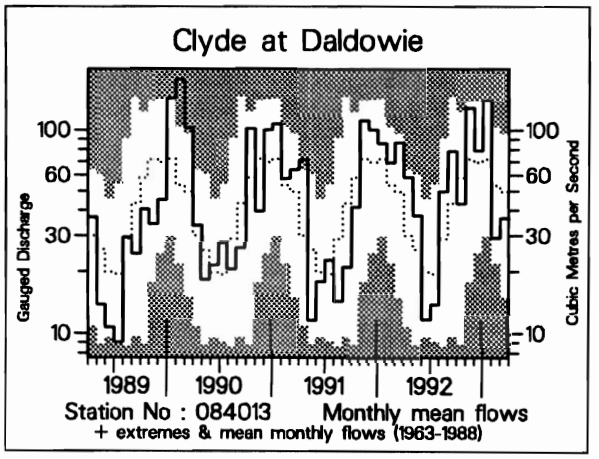

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1989
1990
1991
1992
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO APRIL 1993

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Nov	Dec	1993 Jan	Feb	Mar	Apr	1992 Apr
North West	Northern Command Zone[1]	(G)	133375	64	79	88	98	84	77	94
	Vyrnwy	(R)	55146	81	88	89	86	87	78	100
Northumbria	Teesdale[2]	(G)	87936	79	95	90	98	91	83	96
	Kielder	(R)	199175*	87*	77*	74*	90*	81*	81	92*
Severn-Trent	Clywedog	(R)	44922	86	92	84	96	87	87	99
	Derwent Valley[3]	(G)	39525	79	95	88	99	91	73	100
Yorkshire	Washburn[4]	(G)	22035	70	89	95	99	92	83	90
	Bradford supply[5]	(G)	41407	65	83	94	100	89	76	99
Anglian	Grafham	(R)	58707	95	94	94	96	93	92	95
	Rutland	(R)	130061	95	96	95	93	93	88	74
Thames	London[6]	(G)	206232	96	96	96	96	93	91	91
	Farmoor [7]	(G)	13843	99	95	96	92	96	95	84†
Southern	Bewl	(R)	28170	69	72	82	91	91	91	62
	Ardingly	(R)	4685	81	100	100	100	100	100	100
Wessex	Clatworthy	(R)	5364*	49*	70	100	100	94	83	80
	Bristol WW [8]	(G)	38666*	61*	63*	94*	97*	93*	85*	71*
South West	Colliford	(R)	28540	67	73	82	88	88	83	80
	Roadford	(R)	34500	76	85	90	92	83	80	89
	Wimbleball[9]	(R)	21320	55	71	90	100	99	91	79
	Stithians	(R)	5205	69	82	100	100	98	88	52
Welsh	Celyn + Brenig	(G)	131155	96	98	96	100	96	90	100
	Brianne	(R)	62140	100	100	99	100	96	90	100
	Big Five[10]	(G)	69762	87	91	94	99	91	78	97
	Elan Valley[11]	(G)	99106	100	100	98	100	88	89	100
Lothian	Edinburgh/Mid Lothian	(G)	97639	90	100	98	100	95	93	99
	West Lothian	(G)	5613	84	95	98	99	91	92	94
	East Lothian	(G)	10206	82	91	100	100	99	97	98

● Live or usable capacity (unless indicated otherwise)

* Gross storage/percentage of gross storage

† Intake closure for engineering works caused storage to be lower than it would have been otherwise

Kielder drawn down for ecological management

1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. Lower Thames (includes Queen Mother, Wraysbury, Queen Mary, King George VI and Queen Elizabeth II) and Lee Valley (includes King George and William Girling) groups - pumped storages.
7. Farmoor 1 and 2 - pumped storages.
8. Blagdon, Chew Valley and others.
9. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
10. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
11. Claerwen, Caban Coch, Pen y Garreg and Craig Goch.

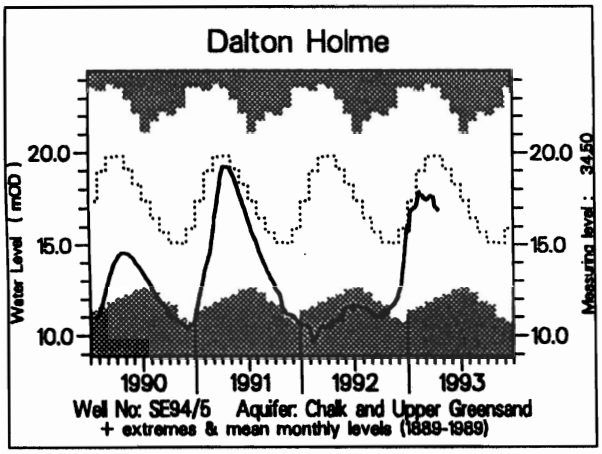
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 provides a link between the hydrological conditions described elsewhere in the report and the water resources situation.

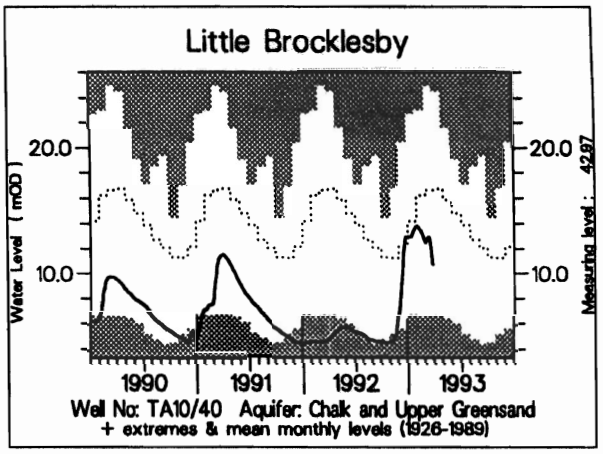
TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

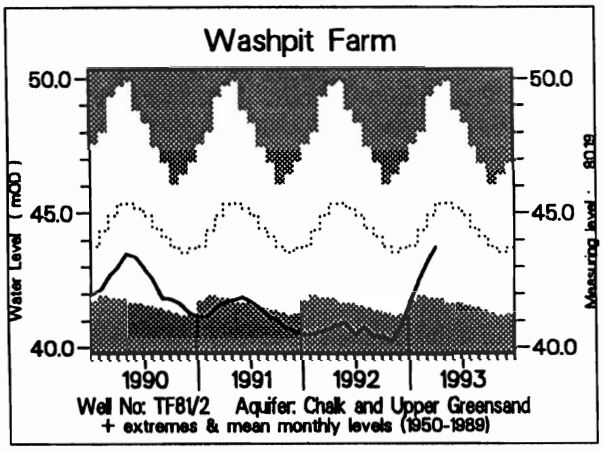
River/ Station name	Nov 1992	Dec	Jan 1993	Feb	Mar 1993		10/92 to 3/93		4/92 to 3/93		5/90 to 3/93		11/88 to 3/93	
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at Park	90 118	80 93	155 172	75 102	66 69	7 /21	526 104	13 /20	800 102	12 /20	2079 91	5 /18	3113 86	2 /17
Tay at Ballathie	148 123	179 128	327 227	111 97	97 76	15 /41	950 124	38 /41	1405 124	36 /40	3604 109	28 /38	6010 117	33 /37
Whiteadder Water at Hutton Castle	48 129	46 102	53 90	20 41	14 28	2 /24	213 81	7 /24	356 92	9 /23	1021 90	8 /21	1366 75	5 /20
South Tyne at Haydon Bridge	117 127	107 108	152 154	22 30	24 28	1 /31	463 90	10 /31	696 92	10 /29	2077 92	7 /25	3188 90	4 /23
Wharfe at Flint Mill Weir	98 123	112 116	132 134	27 35	20 26	1 /38	429 88	11 /38	612 85	8 /37	1784 85	3 /35	2817 85	2 /34
Derwent at Buttercrambe	27 97	55 139	32 70	18 45	20 48	4 /32	174 83	8 /32	262 81	8 /31	661 70	2 /29	964 63	1 /28
Trent at Colwick	52 173	65 149	46 92	18 42	14 35	1 /35	225 98	16 /35	331 94	15 /34	781 76	2 /32	1276 78	1 /31
Lud at Louth	12 85	30 159	30 102	19 56	17 48	6 /25	118 84	9 /25	170 69	6 /24	372 52	2 /22	608 53	1 /21
Witham at Claypole Mill	28 239	39 214	32 127	37 140	13 50	7 /34	172 148	27 /34	223 122	24 /33	413 79	8 /32	641 76	4 /30
Little Ouse at Abbey Heath	16 135	23 140	25 109	14 64	16 73	8 /25	102 99	14 /25	139 83	6 /25	280 58	2 /23	492 65	1 /21
Colne at Lexden	28 232	26 159	29 128	9 49	8 44	4 /34	116 121	28 /34	148 109	22 /33	261 68	3 /31	458 73	1 /30
Lee at Feildes Weir (natr.)	24 178	22 122	28 129	13 66	12 61	29 /107	118 115	73 /107	151 93	48 /105	287 61	7 /102	519 70	9 /99
Thames at Kingston (natr.)	39 182	60 201	55 149	24 72	16 51	17 /111	218 132	87 /110	292 119	82 /110	540 76	13 /108	904 80	10 /106
Coln at Bibury	42 176	88 230	80 158	58 108	36 66	7 /30	333 140	29 /30	449 115	20 /29	954 84	8 /27	1525 85	4 /26
Great Stour at Horton	41 154	46 138	41 101	21 62	18 54	4 /29	186 100	18 /28	255 88	8 /26	606 72	3 /23	916 68	1 /19
Itchen at Highbridge+Allbrook	29 86	54 132	59 123	49 101	44 85	10 /35	259 103	22 /35	392 86	7 /34	1021 77	1 /32	1623 79	1 /31
Piddle at Baggs Mill	29 101	81 199	86 166	53 90	35 62	4 /30	301 118	22 /29	417 104	16 /28	952 81	4 /24	1516 81	2 /21
Exe at Thorverton	169 175	158 121	223 170	31 29	17 20	1 /37	661 107	24 /37	885 108	22 /36	2101 87	6 /35	3286 85	2 /33
Tone at Bishops Hull	45 107	102 156	90 113	29 39	18 31	1 /33	306 90	14 /32	393 85	10 /32	969 71	1 /30	1716 77	1 /28
Severn at Bewdley	70 131	79 127	71 100	21 36	12 26	1 /72	279 87	20 /72	414 92	28 /72	1054 80	7 /70	1753 84	3 /68
Cynon at Abercynon	291 191	280 151	299 154	38 27	23 19	1 /35	985 108	23 /35	1470 117	24 /33	3435 93	11 /29	5635 97	14 /27
Dee at New Inn	302 124	232 95	275 115	30 18	36 20	1 /24	997 79	4 /24	1579 88	7 /23	4500 84	1 /21	7267 87	1 /20
Eden at Sheepmount	110 131	118 131	157 151	30 40	26 37	1 /23	481 98	12 /22	699 102	10 /21	1974 98	7 /17	3154 100	7 /14
Clyde at Daldowie	174 181	111 112	197 184	37 49	52 69	10 /30	631 117	22 /30	975 125	28 /29	2679 117	25 /27	4144 117	25 /26

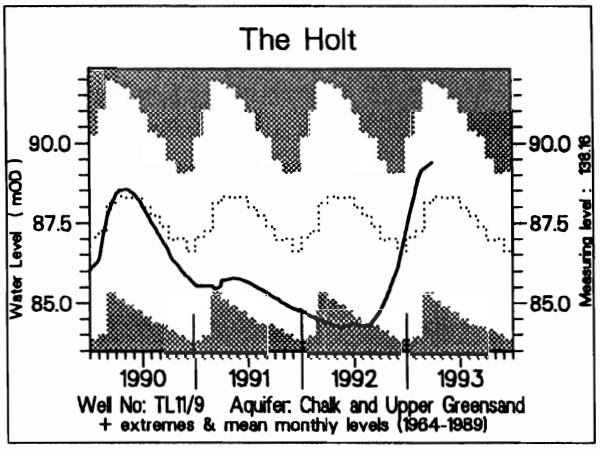
Notes:
(i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1991. For the long periods (at the right of this table), the end date for the long term is 1993.

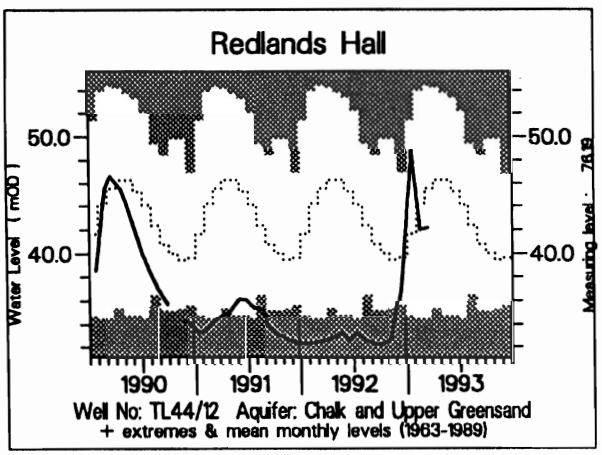
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

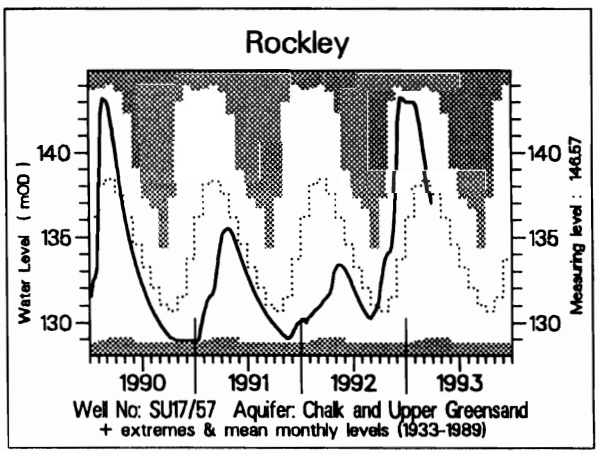


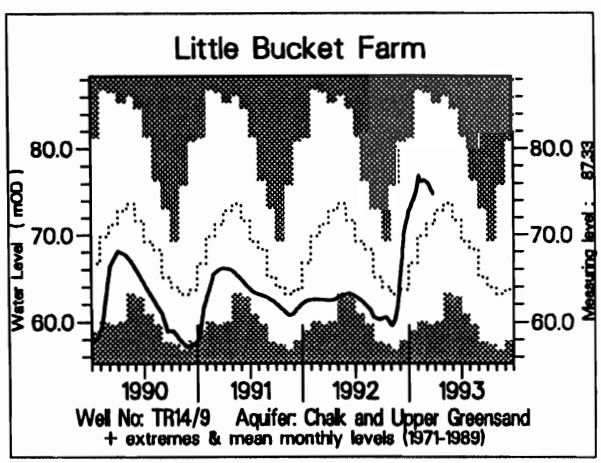


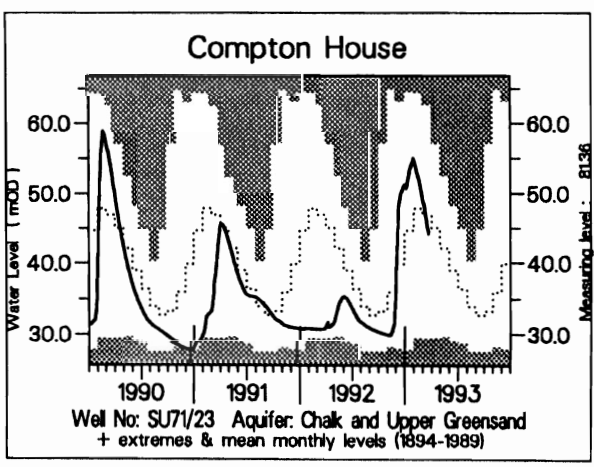


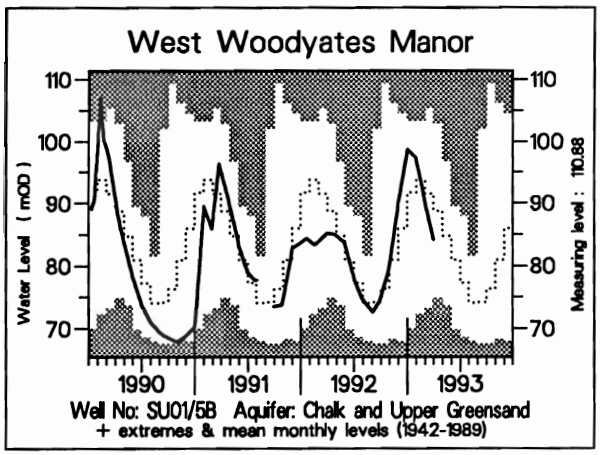


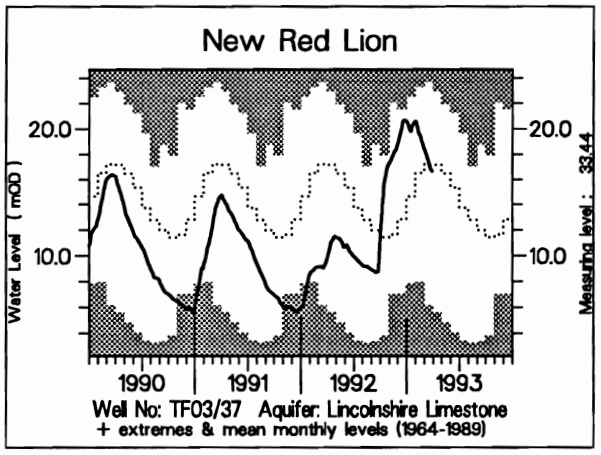


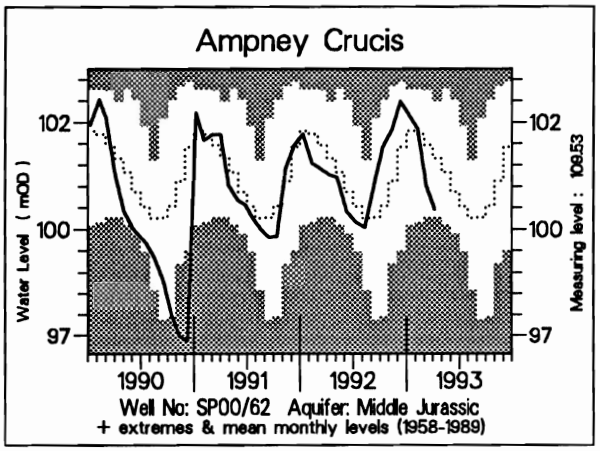


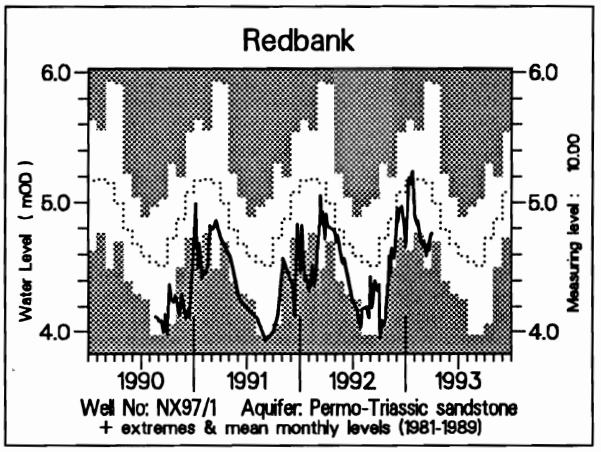


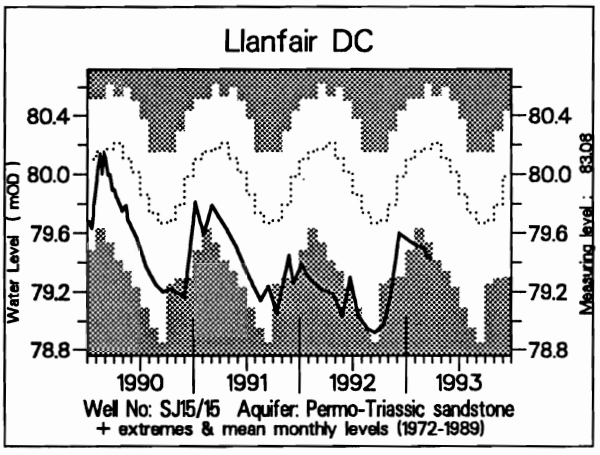


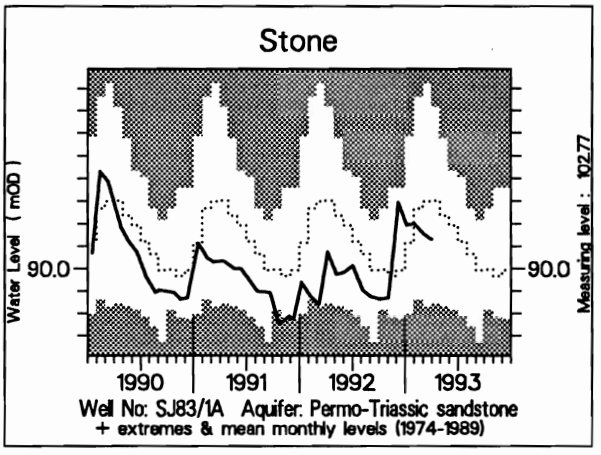

West Woodyates Manor
Water Level (mOD)
Measuring level : 110.88
110
100
90
80
70
1990
1991
1992
1993
Well No: SU01/5B Aquifer: Chalk and Upper Greensand
+ extremes & mean monthly levels (1942-1989)

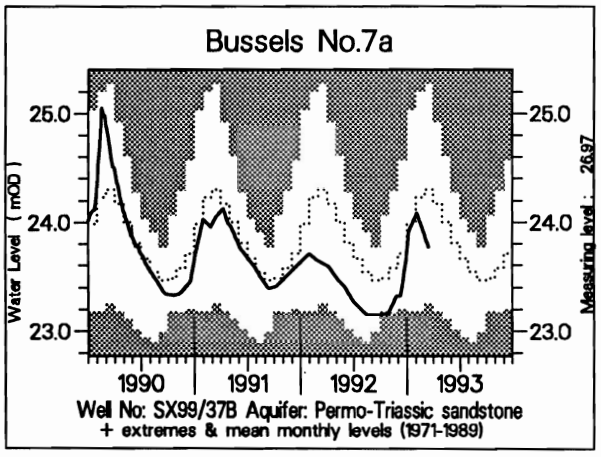

New Red Lion
Water Level (mOD)
Measuring level : 33.44
20.0
10.0
1990
1991
1992
1993
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1989)


Ampney Crucis
Water Level (mOD)
Measuring level : 109.53
102
100
97
1990
1991
1992
1993
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1989)


Redbank
Water Level (mOD)
Measuring level : 10.00
6.0
5.0
4.0
1990
1991
1992
1993
Well No: NX97/1 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1981-1989)


Llanfair DC
Water Level (mOD)
Measuring level : 83.08
80.4
80.0
79.6
79.2
78.8
1990
1991
1992
1993
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1989)


Stone
Water Level (mOD)
Measuring level : 102.77
90.0
1990
1991
1992
1993
Well No: SJ83/1A Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1974-1989)


Bussels No.7a
Water Level (mOD)
Measuring level : 26.97
25.0
24.0
23.0
1990
1991
1992
1993
Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1989)

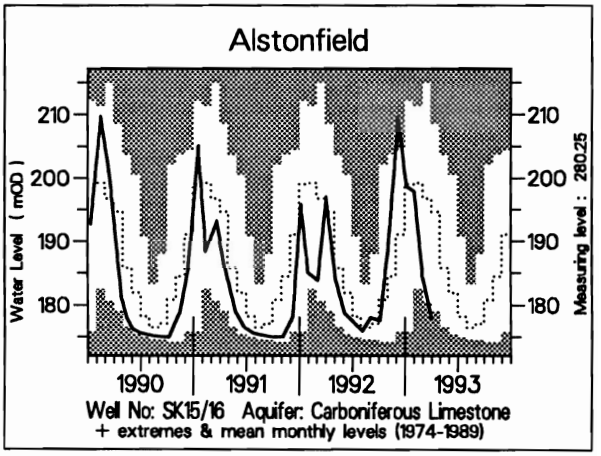

Alstonfield
Water Level (mOD)
Measuring level : 280.25
210
200
190
180
1990
1991
1992
1993
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1989)

TABLE 5 A COMPARISON OF MARCH GROUNDWATER LEVELS: 1992 AND 1993

Site	Aquifer	Records commence	Average March level	March 1992		March/April 1993		No of years March level <1993	Least pre-1993 level
				day	level	day	level		any month
Wetwang	C & UGS	1971	25.12	20/03	17.21	31/03	21.01	3	16.66
Dalton Holme	C & UGS	1889	19.73	24/03	10.44	14/04	17.01	>10	9.64
Little Brocklesby	C & UGS	1926	15.52	27/03	4.76	26/03	10.70	6	4.53
Washpit Farm	C & UGS	1950	44.87	03/03	40.61	01/04	43.73	>10	40.32
The Holt	C & UGS	1964	87.54	22/03	84.47	29/03	89.40	>10	83.90
Therfield Rectory	C & UGS	1883	79.05	22/03	dry	26/03	80.13	>10	dry <71.6
Redlands Farm	C & UGS	1964	44.14	23/03	32.66	12/03	42.17	10	32.29
Rockley	C & UGS	1933	138.34	22/03	131.36	29/03	136.99	>10	dry <128.9
Little Bucket Farm	C & UGS	1971	70.98	30/03	62.45	26/03	74.83	>10	56.77
Compton House	C & UGS	1894	46.68	29/03	30.93	23/03	44.13	>10	27.64
Chilgrove House	C & UGS	1836	55.65	29/03	40.31	23/03	52.13	>10	33.46
West Dean No 3	C & UGS	1940	2.17	27/03	1.49	26/03	1.82	>10	1.01
Lime Kiln Way	C & UGS	1969	125.46	25/03	124.07	25/03	124.40	1	123.70
Ashton Farm	C & UGS	1974	68.50	30/03	68.00	31/03	68.50	3	63.10
West Woodyates	C & UGS	1942	90.66	30/03	85.20	31/03	84.16	8	67.62
New Red Lion	LLst	1964	16.46	24/03	9.20	29/03	16.61	>10	3.29
Ampney Crucis	Mid Jur	1958	102.06	09/03	101.42	07/04	100.46	2	97.38
Yew Tree Farm	PTS	1973	13.55	31/03	13.14	31/03	13.64	9	8.43
Llanfair DC	PTS	1972	80.06	02/03	79.24	28/03	79.42	1	78.85
Morris Dancers	PTS	1969	32.54	09/03	32.04	08/03	31.87	1	30.87
Stone	PTS	1974	90.55	01/03	90.32	01/04	90.26	6	89.34
Skirwith	PTS	1978	130.70	05/03	130.57	26/03	130.42	3	129.44
Redbank	PTS	1981	5.06	01/03	4.66	30/03	4.76	2	3.93
Bussels 7A	PTS	1972	24.29	10/03	23.63	16/03	23.77	3	22.90
Rusheyford NE	MgLst	1967	72.23	03/03	74.63	10/03	75.01	>10	64.77
Peggy Ellerton	MgLst	1968	34.66	09/03	31.97	18/03	31.98	2	31.10
Alstonfield	CLst	1974	195.77	10/03	183.77	01/04	177.83	0	174.22

groundwater levels are in metres above Ordnance Datum

C & UGS	Chalk and Upper Greensand	Mid Jur	Middle Jurassic limestones
LLst	Lincolnshire Limestone	MgLst	Magnesian Limestone
PTS	Permo-Triassic sandstones	CLst	Carboniferous Limestone

FIGURE 3 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS