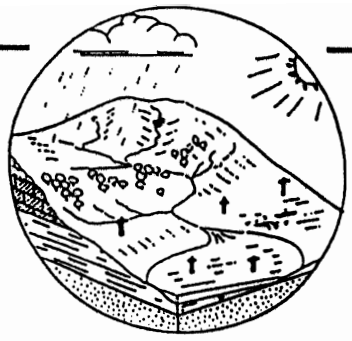
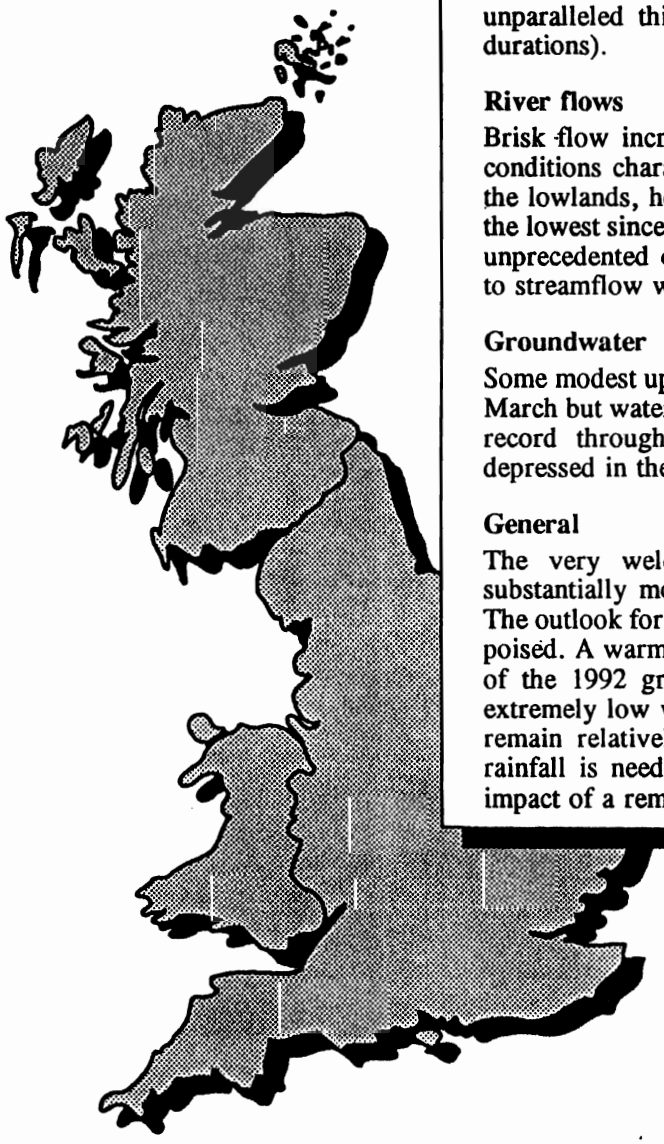
Hydrological Summary for Great Britain





MARCH 1992

Rainfall

Approaching 150% of the March average for Great Britain with substantial rainfall in almost all regions. March ended lengthy sequences of relatively dry months in the English lowlands but long term deficiencies remain exceptional - unparalleled this century in some areas (over a range of durations).

River flows

Brisk flow increases occurred late in the month and spate conditions characterised some north-eastern catchments. In the lowlands, however, March mean flows were commonly the lowest since 1976 and winter half-year runoff totals were unprecedented over wide areas. Groundwater contributions to streamflow were extremely limited in the east.

Groundwater

Some modest upturns in groundwater levels were detected in March but water-tables remain at their lowest spring level on record throughout much of the Chalk aquifer and are depressed in the Permo-Triassic sandstones also.

General

The very welcome March rainfall was insufficient to substantially moderate drought intensities in the lowlands. The outlook for further, greatly needed, recharge is critically poised. A warm, dry spell in late April could signal the start of the 1992 groundwater recession - and the prospect of extremely low water-tables in the autumn. Reservoir stocks remain relatively healthy but, in the lowlands, prolonged rainfall is needed over the next six weeks to mitigate the impact of a remarkably protracted drought.

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HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - MARCH 1992

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 4) is provided to assist in the location of the principal monitoring sites.

Rainfall

Very mild weather characterised early March and the rainfall distribution followed a now familiar pattern; western and northern Britain being favoured. Around mid-month conditions became much more wintry as a north-easterly airflow, rare in recent years, brought very welcome precipitation to the eastern seaboard and the English lowlands. The last week of the month was especially unsettled with rain, hail, sleet and snow all reported in some districts. In many areas the ten days beginning around the 24th March included the wettest spell of weather since early January. Spate conditions resulted in south-east Scotland and localised flooding was reported in eastern England (an incongruous accompaniment to the extension of hosepipe bans in some areas).

For Britain as a whole, March was the second wettest month since January 1991 and in much of eastern England a sequence of seven or eight successive months with below average rainfall was terminated. The South-West was relatively dry but in parts of northern England, East Anglia and, more extensively in Scotland, rainfall reached 200% of the 1941-70 average. However, March is normally the driest month of the year in many regions and the percentage rainfall totals give a somewhat exaggerated impression of its significance. Although substantial rainfall was registered over many major aquifer outcrop areas - notably in East Yorkshire and Lincolnshire - in others, for instance the eastern Chilterns, the March rainfall barely reached the 1941-70 mean.

Rainfall in late March served to moderate rainfall deficiencies in most regions and the winter half-year rainfall, though low in the east, considerably exceeded that for other modern droughts (notably 1975/76). However, the current drought is a manifestation of a very protracted rainfall shortage and long term rainfall deficiencies remain exceptional, extreme in some eastern districts. For England and Wales as a whole, rainfall is 20% below average for the period beginning in March 1990; only in the 1933/34 drought has such a shortfall been approached this century (for ANY 25-month accumulations). Additionally, the three- and four-year rainfall accumulations ending in March are also closely comparable to the lowest since 1900; similar nationwide deficiencies occurred only in the 1780s, 1800s and 1850s.

Despite the March rainfall, the drought remains most severe in the English lowlands. East Anglia recorded only its fourth month with above average rainfall since February 1990 (some districts have registered only around six since the spring of 1988 and accumulated deficiencies are equivalent to a full year's rainfall). Similarly, catchment rainfall totals for the Thames Valley are the lowest in a 110-year record over a wide range of durations (extending beyond 48 months). Over the four-year timespan the rainfall total for Great Britain closely approaches the long term average and a measure of the atypical rainfall distribution since the spring of 1988 is provided by the contrast between the drought in south-east England and the notably high rainfall totals for north-west Scotland (see Table 2).

Sustained April and early May rainfall is required in the lowlands to help mitigate the drought's impact in the summer of 1992.

Evaporation and Soil Moisture Deficits

Overall, March was a cloudy month but mild and windy conditions helped to maintain evaporation rates towards the upper end of the normal range for early spring. Evaporation losses for the winter half-year were also appreciably above average in most regions. 1991/92 was the third notably mild winter in the last four years and, generally, MORECS evaporation losses since 1987 have remained above, to well above, the 1961-87 mean.

The area over which soils remain short of field capacity contracted substantially over the latter half of the month. By month-end, significant SMDs were confined to the lower Thames Valley (near the estuary soils are still remarkably dry with deficits around 80 mm - easily the highest in the MORECS series for the early spring). Away from this zone the prospects for further infiltration in April are good but the outlook for recharge in the short term is critically poised. Sustained April rainfall will produce very valuable recharge but a warm, dry spell late in the month could signal the beginning of the 1992 recession in the east (see below).

River Flows

Many rivers registered large flow ranges in March and, generally, the trend ran counter to the normal seasonal decline in runoff rates. In contrast to the rainfall picture, river flow recoveries were most marked in some western and northern catchments; dry soils reduced the impact of the rainfall in the east. Brisk increases in flows were, nonetheless, widely reported from around the 24th and some notable peak flows were registered in south-east Scotland. On the 31st, when a rainfall total of 94 mm was recorded at Whiteadder Reservoir (Borders Region), the highest instantaneous flow on the Tweed (at Norham) exceeded 1340 m^3s^{-1} placing it among the highest half dozen flow rates on the Surface Water Archive for rivers south of the Scottish Highlands. Spate conditions were also reported from the Northumbria and Yorkshire regions in early April but in the South-East increases in runoff were muted and shortlived - the exceptionally depressed nature of baseflows in the English lowlands led to correspondingly steep recessions at the beginning of April.

Monthly runoff totals were similar to those of February in many lowland catchments. Broadly speaking runoff was above average in Scotland, northern England and parts of Wales, but exceptionally depressed in the lowlands. Typically only in 1976 have lower March flows been registered in the lowlands over the last 30 years. In some rivers, including the Itchen, Mimram and Teme, the March runoff was unprecedented. Long data series for the Thames and Lee provide a fuller historical perspective - they suggest that, 1976 excepted, only in 1944 have lower March runoff totals been registered this century in the Thames basin.

Catchments registering new minimum winter half-year runoff totals showed a wide distribution (see Table 3). Most notably, the River Lee (at Feildes Weir) recorded its lowest October-March accumulated runoff total in a series from 1883. Average flow for the winter half-year was only a quarter of the long term average, many other lowland rivers registered between 30% and 40%. Helped by baseflow support from the Cotswolds, the winter half-year runoff for the Thames was only the sixth lowest on record; flows were appreciably above those in 1933/34, 1943/44 and 1975/76. A more telling index of the persistence and severity of the current drought emerges if a two-year timespan is considered. The accumulated runoff total for the Thames over the period beginning in April 1990 has been closely approached only during the 1900-02 and 1933-35 droughts, (a fact made the more remarkable by the underestimation of the pre-1951 flows at Teddington weir). Table 3 confirms the exceptionally depressed nature of runoff in eastern, central and southern England in the 24-month and 44-month timeframes. In groundwater-fed rivers in the east, sequences of below average monthly runoff totals extend back to the autumn of 1988 and the accumulated deficiency is without recent parallel.

Reservoir replenishment was somewhat patchy in March but generally considerable over the fortnight beginning around the 24th. With the exception of a few smaller impoundments (in the South West, for instance) stocks remain relatively healthy even in the lowlands - where they are broadly comparable to those of early April 1991.

Groundwater

Proportionally, the shortfall in groundwater replenishment since early 1988 is very much greater than that for rainfall. In much of the eastern lowlands, four successive years with modest recharge, separated by extended groundwater level recessions, have produced remarkably depressed water-tables. This is particularly true of the Chalk aquifer from Hertfordshire to Humberside where the accumulated recharge over the past four winters is generally less than 50% of the long-term average. There is no modern parallel for such a shortfall and early-spring groundwater levels are the lowest on record over wide areas.

In parts of the eastern Chalk outcrop, very modest upturns in groundwater levels could be identified in late March but any substantial recovery is still awaited. At Wetwang, Dalton Holme, Little Brocklesby, Washpit Farm, Fairfields and Redlands Hall Farm, levels are still beneath the seasonal minima. In the Thames Valley, groundwater levels also remain close to, or below, the seasonal minima in the Chalk of the North Downs, the Berkshire Downs, the Chilterns and the River Lee catchment. No seasonal upturn has yet been detected in much of the southern Chalk but, as elsewhere, declines have been arrested. By way of contrast, groundwater levels in northern England, in the north Midlands, and especially in south-west England were still falling in March although still generally above the seasonal minima in most areas. The site at Llanfair DC, in the Permo-Triassic sandstones of North Wales, showed a falling groundwater level near the beginning of March which was already beneath the seasonal minimum, but no later measurements are yet available. In interpreting the data presented in Table 5 particular attention should be paid to the date of the last reading - in some areas significant recharge will have occurred subsequently.

The fragility of the current groundwater outlook is evident from Table 5. In the zone of maximum drought intensity - Humberside to the Thames - March levels were close to or below the pre-1992 minimum (for any month). This at a time when, on average, peak levels for the year are recorded. A rough guide to the likely rarity of the current spring levels may be obtained by relating the number of years with lower March levels to the overall record length (see Table 5). Particular caution is required in relation to the Therfield series; measurement precision may not be consistent through the full record and the six years when the well has dried embrace only three separate drought episodes - it may well be that only in 1902 were levels as depressed as those of early April 1992.

In the eastern Chalk, substantial further recharge will be required to return levels to even the minimum recorded for the late-spring. With little time remaining before soil moisture deficits begin to build once more there is no realistic chance of any major recovery. A wet April and early May - as happened in 1989, would however usefully delay the onset of the summer recession and reduce the likelihood of 1992 minimum falling much below the late 1991 levels.

Realistic predictions of the probable groundwater resources outlook during and towards the end of the 1992 summer cannot be made at least until the end of April by which time the normal summer recessions are likely to have become established. It would seem probable that these will be starting at generally very low levels.

Institute of Hydrology/British Geological Survey
10 April 1992

TABLE 1 1991/92 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec 1991	Jan 1992	Feb	Mar
England and	mm	75	69	14	90	68	31	62	75	90	49	47	42	79
Wales	%	127	119	21	148	93	34	75	90	92	54	55	64	133
NRA REGIONS														
North West	mm	110	67	18	105	67	65	68	111	152	118	54	97	133
	%	153	87	22	127	65	52	55	94	126	98	48	120	185
Northumbria	mm	85	41	22	69	53	37	42	75	105	78	32	68	99
	%	163	75	34	113	69	37	53	100	112	104	30	103	191
Severn-Trent	mm	59	67	11	74	77	21	55	54	69	39	58	31	68
	%	113	129	17	132	118	26	82	83	87	56	84	58	131
Yorkshire	mm	63	49	14	73	36	21	40	63	93	61	46	42	82
	%	119	88	23	126	51	23	56	91	104	82	60	65	155
Anglian	mm	29	45	13	77	38	18	62	26	53	23	45	17	62
	%	73	113	28	157	67	28	119	50	85	44	86	39	155
Thames	mm	45	63	13	96	79	19	52	36	66	16	28	22	49
	%	98	137	23	185	132	27	84	56	90	25	45	47	107
Southern	mm	59	56	17	125	88	15	50	51	81	23	18	30	60
	%	113	117	31	250	149	21	70	65	86	28	24	52	115
Wessex	mm	81	72	10	107	73	19	70	84	71	30	36	34	59
	%	140	133	15	198	118	23	89	102	73	33	43	57	100
South West	mm	127	100	9	127	90	32	84	123	112	52	44	64	70
	%	151	141	11	195	107	32	81	109	84	39	34	71	83
Welsh	mm	127	124	15	111	97	54	85	153	138	67	75	75	122
	%	146	144	16	135	102	45	68	119	97	46	55	78	140
Scotland	mm	127	123	41	122	91	67	129	162	222	143	132	136	158
	%	138	137	45	133	81	52	94	109	156	92	96	131	171
RIVER PURIFICATION BOARDS														
Highland	mm	141	131	63	125	105	86	181	191	294	173	180	209	219
	%	124	115	61	114	83	58	115	103	174	88	110	157	192
North-East	mm	81	62	46	131	57	34	57	116	129	50	67	58	105
	%	131	102	60	187	62	32	66	120	125	49	74	78	169
Tay	mm	117	110	23	135	93	41	108	146	147	91	109	93	165
	%	143	147	24	163	91	35	94	120	124	68	92	101	201
Forth	mm	103	90	18	110	97	38	99	109	112	109	108	90	141
	%	149	132	21	147	99	33	92	103	104	100	109	117	205
Tweed	mm	93	62	21	90	65	36	66	99	120	90	67	80	113
	%	160	102	28	132	73	32	71	113	115	100	72	116	195
Solway	mm	150	148	17	122	77	69	79	175	198	157	89	166	184
	%	165	168	18	136	70	53	52	122	137	104	64	178	203
Clyde	mm	156	184	33	129	108	87	157	190	274	209	165	185	193
	%	149	179	34	125	83	61	90	104	164	112	102	164	198

Note: The most recent monthly rainfall figures for England and Wales correspond to the MORECS areal assessments derived by the Meteorological Office; for the Scottish RPBs the February and March 1992 totals were estimated from the isohyetal map provided with the MORECS bulletin. 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 RETURN PERIOD ESTIMATES

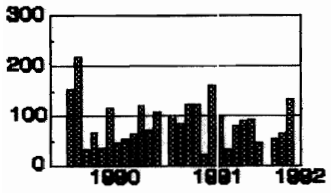
		Oct91-Mar92		Apr91-Mar92		Mar90-Mar92		Aug88-Mar92	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales ▲	mm	380		717		1512		2926	
	% LTA	79	5-10	79	15-25	80	60-90	86	35-50
NRA REGIONS									
North West	mm	673		1063		2231		4219	
	% LTA	108	2-5	87	5-10	89	5-10	93	5-10
Northumbria	mm	457		721		1620		2838	
	% LTA	103	2-5	82	5-15	90	5-10	87	20-30
Severn Trent	mm	318		623		1274		2461	
	% LTA	82	5-10	81	10-15	80	35-50	86	30-40
Yorkshire	mm	388		621		1390		2618	
	% LTA	91	2-5	75	25-40	81	35-50	85	40-60
Anglian	mm	224		477		934		1790	
	% LTA	75	5-15	78	10-20	74	150-250	80	150-250
Thames	mm	218		540		1050		2111	
	% LTA	61	30-40	77	10-20	72	150-250	81	80-120
Southern	mm	264		615		1253		2405	
	% LTA	60	30-45	77	10-20	76	70-100	81	80-120
Wessex	mm	313		665		1354		2734	
	% LTA	67	10-20	77	10-20	75	80-120	84	35-50
South West	mm	466		908		2012		4015	
	% LTA	68	10-20	76	15-25	81	30-40	90	5-15
Welsh	mm	626		1111		2329		4582	
	% LTA	85	2-5	83	5-10	85	10-20	92	5-10
Scotland	mm	934		1507		3342		6019	
	% LTA	120	10-15	105	2-5	110	5-15	113	60-90
RIVER PURIFICATION BOARDS									
Highland	mm	1266		1957		4081		7720	
	% LTA	132	35-50	114	5-10	114	20-30	120	>200
North-East	mm	525		912		1940		3404	
	% LTA	99	<2	89	5-10	92	5-10	90	10-20
Tay	mm	751		1261		2609		4974	
	% LTA	113	2-5	100	<2	101	2-5	107	5-10
Forth	mm	669		1121		2394		4434	
	% LTA	118	5-10	100	<2	104	2-5	107	5-10
Tweed	mm	569		909		1974		3516	
	% LTA	113	2-5	91	2-5	96	2-5	95	2-5
Solway	mm	969		1481		2970		5572	
	% LTA	127	10-20	104	2-5	101	2-5	105	2-5
Clyde	mm	1216		1914		3920		7374	
	% LTA	133	35-50	115	5-15	114	15-25	118	>200

Return period assessments are based on tables provided by the Meteorological Office*. These 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. "Wet" return periods underlined.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

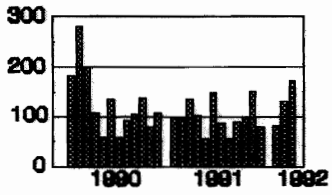
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office (HMSO).

Erratum: In the February 1992 monthly summary column 1 referred to Dec 91 - Feb 92 rainfall (not Oct 91 - Feb 92).

FIGURE 1. MONTHLY RAINFALL FOR 1990-1992 AS A PERCENTAGE OF THE 1941-1970 AVERAGE



England and Wales



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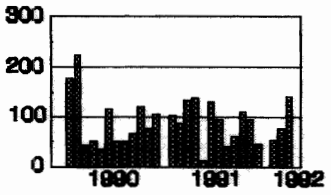

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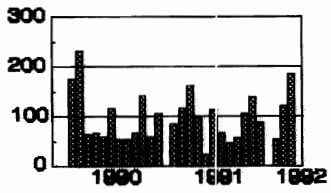
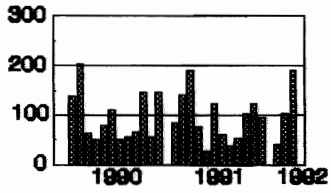
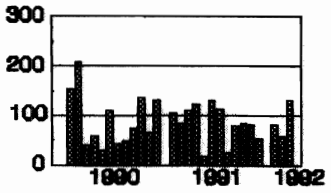


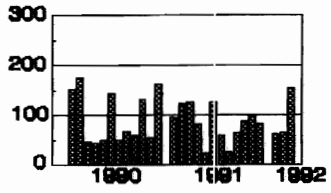
North West Region



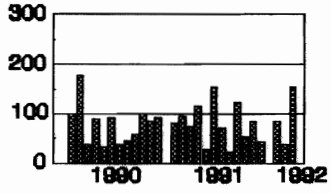
Northumbria Region



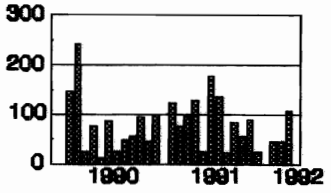
Severn-Trent Region



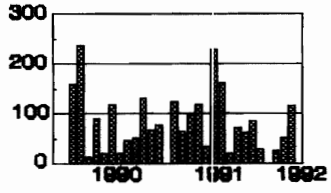
Yorkshire Region



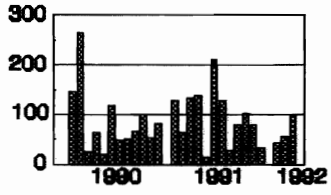
Anglian Region



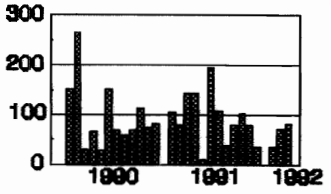
Thames Region



Southern Region

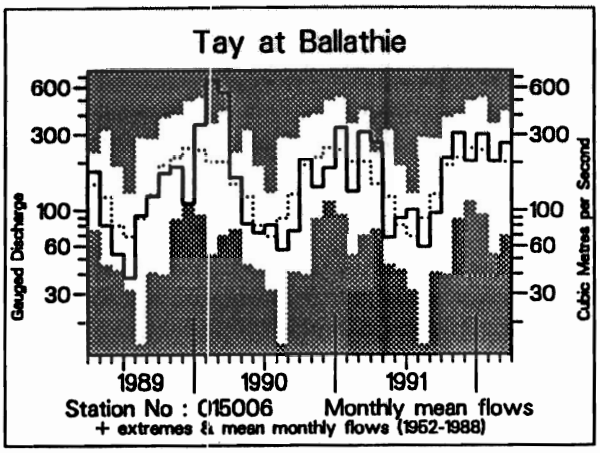


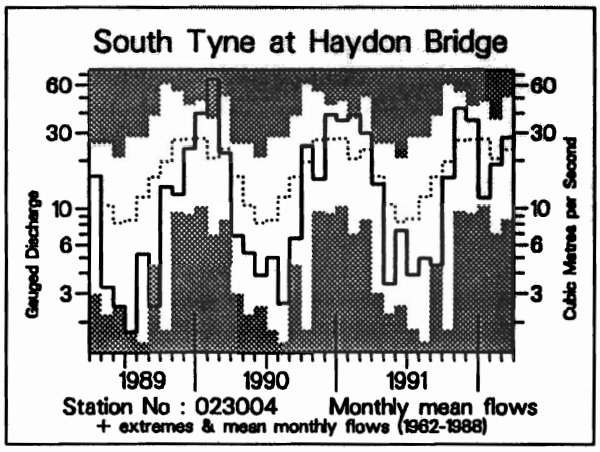
Wessex Region

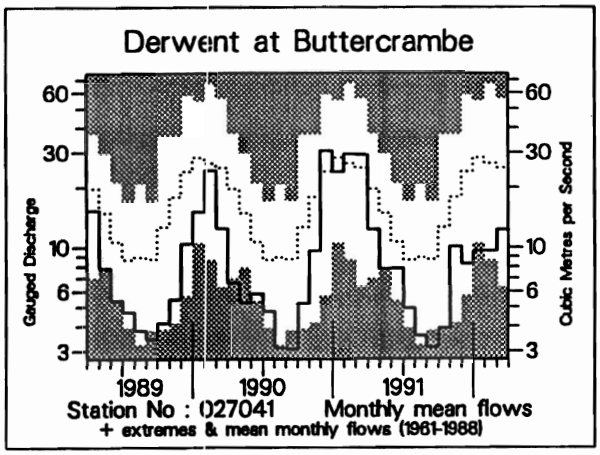


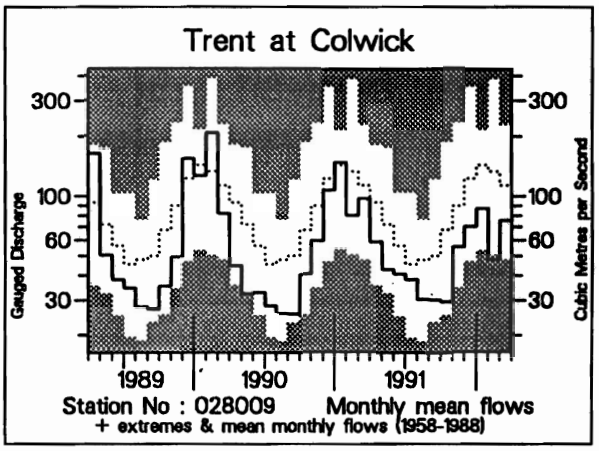
South West Region

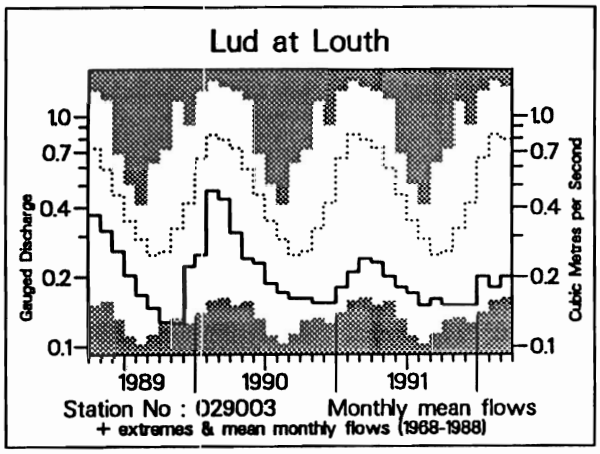
FIGURE 2 RIVER FLOW HYDROGRAPHS

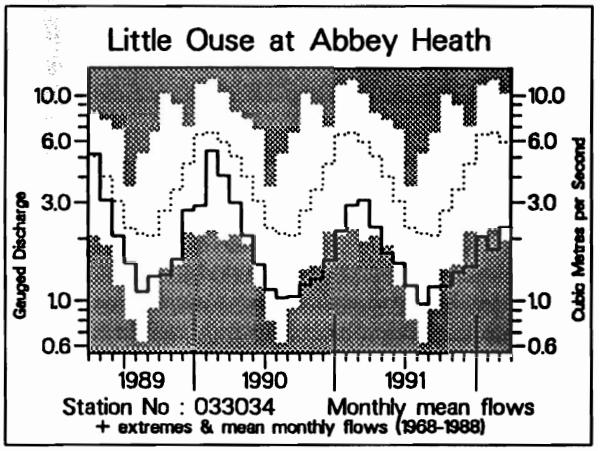


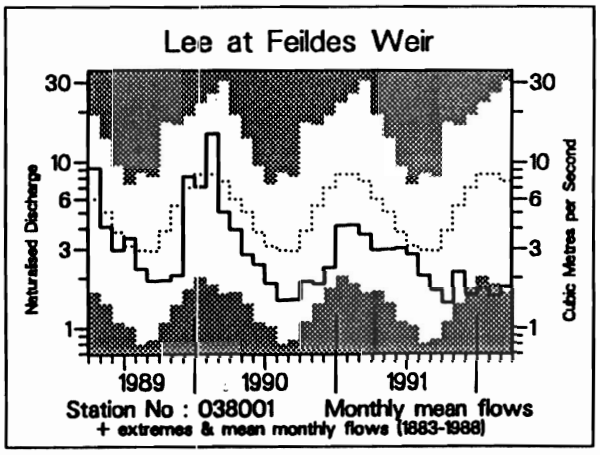


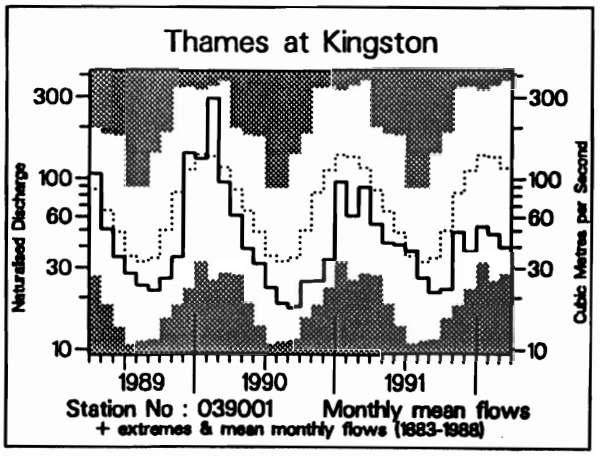


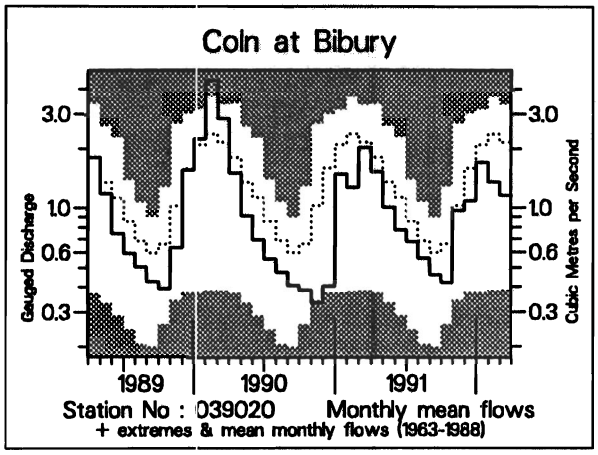


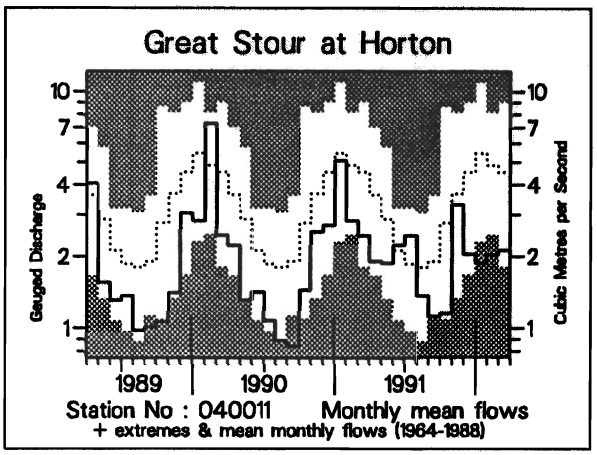


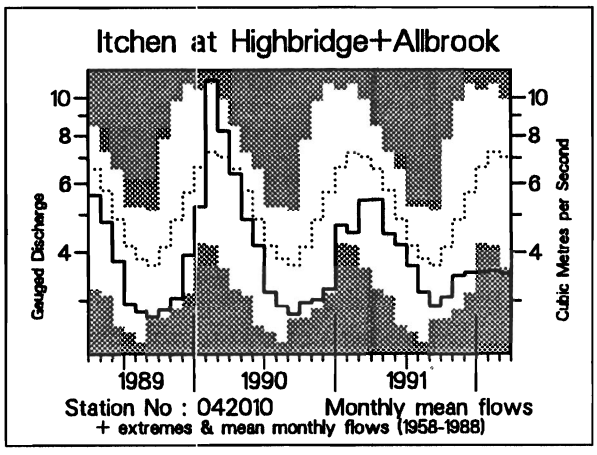


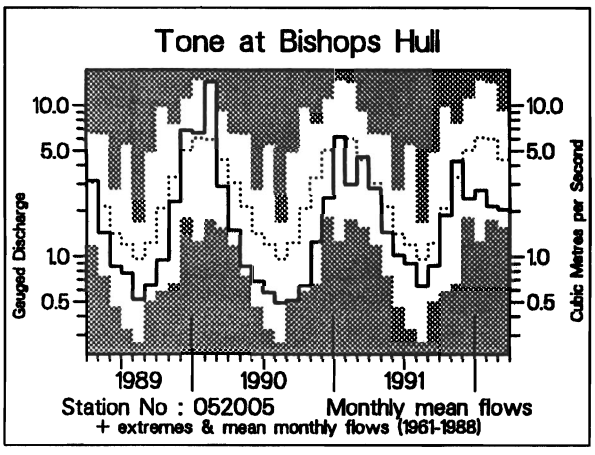


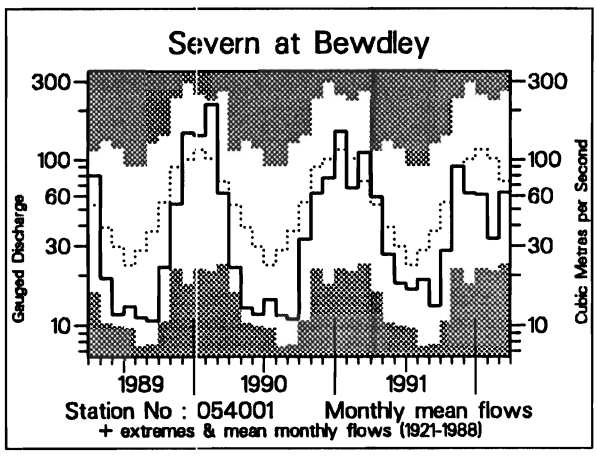


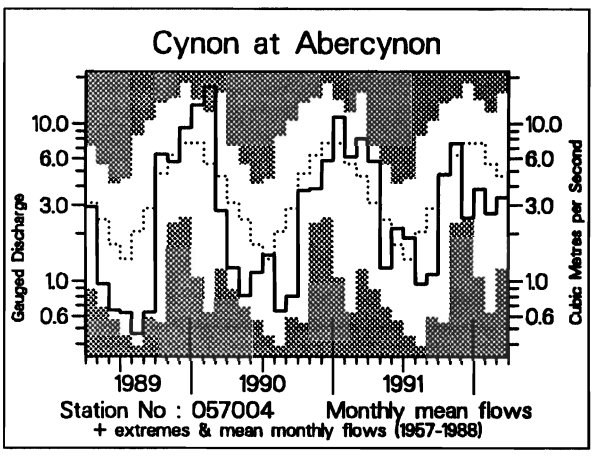

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1989
1990
1991
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

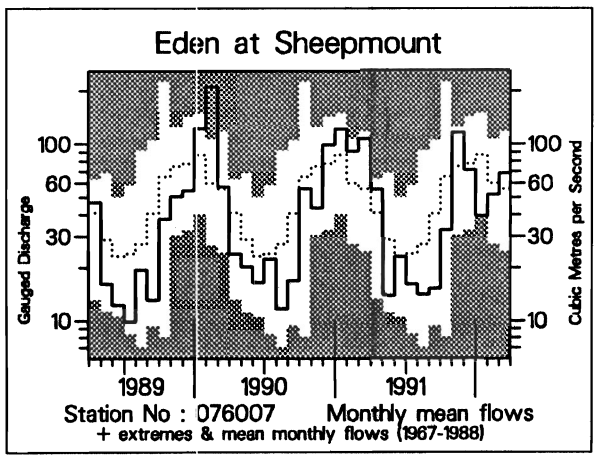

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10
7
4
2
1
1989
1990
1991
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10
8
6
4
1989
1990
1991
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
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
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
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
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1988)

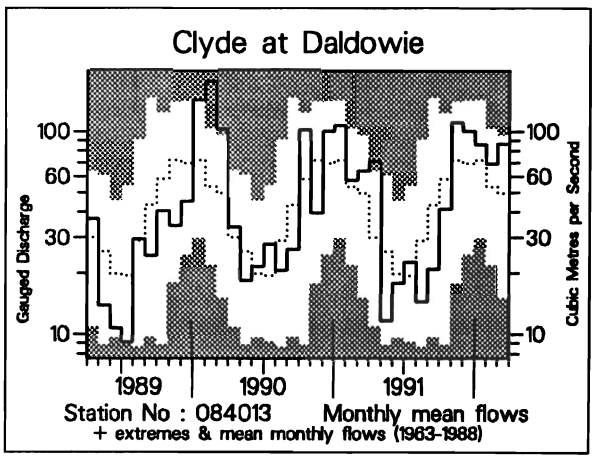

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1989
1990
1991
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

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 1991	Dec 1991	Jan 1992	Feb 1992	Mar 1992		10/91 to 3/92		4/91 to 3/92		4/90 to 3/92		8/89 to 3/92	
	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	122 165	44 50	61 67	38 51	65 71	6 /20	399 79	3 /19	651 83	3 /19	1313 83	3 /18	2548 85	1 /16
Tay at Ballathie	173 145	118 84	176 124	111 96	154 122	29 /40	858 113	34 /40	1245 110	30 /39	2295 102	24 /38	5069 119	34 /36
Whiteadder Water at Hutton Castle	35 94	30 66	38 65	21 43	41 83	10 /23	175 66	5 /23	240 62	4 /22	674 86	7 /21	1092 73	4 /19
South Tyne at Haydon Bridge	148 165	128 131	41 42	62 85	100 119	22 /30	535 104	17 /30	666 88	6 /28	1405 92	6 /26	2651 90	5 /22
Wharfe at Flint Mill Weir	117 149	91 94	61 62	49 64	96 127	29 /37	449 92	14 /37	586 81	5 /36	1193 83	3 /35	2416 87	4 /33
Derwent at Buttercrambe	17 60	14 35	16 35	15 38	21 51	3 /31	898 42	2 /31	155 48	1 /30	414 63	1 /29	762 61	1 /27
Trent at Colwick	19 63	25 56	31 62	16 37	27 67	8 /34	128 56	2 /34	212 60	2 /33	466 66	1 /32	1001 75	1 /30
Lud at Louth	7 48	7 36	10 33	9 26	10 27	2 /24	49 35	2 /24	101 40	1 /23	215 43	1 /22	478 51	1 /21
Witham at Claypole Mill	7 59	7 38	15 59	9 34	11 42	5 /33	53 46	5 /33	93 51	2 /32	202 56	2 /31	437 64	2 /30
Little Ouse at Abbey Heath	5 41	6 36	8 34	6 27	9 40	2 /24	38 36	1 /24	71 42	1 /24	152 45	1 /23	385 61	1 /21
Colne at Lexden	5 41	5 30	7 30	5 27	8 43	5 /33	33 35	3 /33	58 43	1 /32	120 45	1 /31	328 65	1 /29
Lee at Feildes Weir (Natr.)	5 37	4 22	4 18	4 20	5 25	2 /106	26 25	1 /106	65 40	4 /104	146 45	5 /102	398 66	9 /99
Thames at Kingston (natr.)	12 56	10 33	14 38	12 36	11 35	3 /110	66 40	6 /109	125 51	6 /109	262 53	2 /108	642 70	6 /106
Coln at Bibury	23 96	27 70	43 84	32 59	29 53	4 /29	164 70	6 /29	287 74	6 /28	542 69	2 /27	1119 77	2 /25
Great Stour at Horton	25 94	16 47	15 37	15 44	16 47	3 /28	95 51	1 /27	179 61	1 /25	367 62	1 /23	703 63	1 /20
Itchen at Highbridge+Allbrook	25 73	26 63	26 54	25 51	26 50	1 /34	151 60	1 /34	325 71	1 /33	675 73	1 /32	1308 77	1 /30
Piddle at Baggs Mill	30 105	29 71	26 50	24 40	25 44	2 /29	155 62	3 /28	305 76	5 /27	569 71	1 /25	1144 76	1 /21
Exe at Thorverton	128 134	75 57	48 37	37 35	68 80	17 /36	412 67	2 /36	572 70	2 /35	1235 75	1 /34	2631 83	3 /33
Taw at Umberleigh	162 181	53 45	41 35	34 39	45 66	10 /34	330 62	2 /34	441 64	2 /33	1020 74	2 /32	2270 86	4 /30
Tone at Bishops Hull	55 133	32 48	36 45	27 36	27 47	4 /32	201 59	2 /31	301 64	3 /31	595 63	1 /30	1404 78	1 /28
Severn at Bewdley	54 101	39 62	38 54	19 33	39 85	36 /71	206 64	5 /71	298 66	4 /71	651 72	3 /70	1443 84	7 /68
Wye at Cefn Brwyn	315 126	192 68	145 59	132 76	317 180	34 /38	1268 95	14 /37	1977 96	14 /33	3849 92	8 /28	7595 96	6 /20
Cynon at Abercynon	182 120	63 33	96 50	63 45	85 72	16 /34	610 67	5 /34	932 75	4 /32	2039 81	4 /30	4530 94	10 /26
Dee at New Inn	260 107	189 76	114 47	102 60	246 137	18 /23	1058 83	5 /23	1473 82	5 /22	2979 82	2 /21	6253 89	2 /20
Eden at Sheepmount	132 162	83 92	46 45	57 77	80 117	15 /22	436 89	8 /21	594 87	7 /20	1314 96	9 /18	2653 102	7 /14
Clyde at Daldowie	151 160	140 143	120 114	90 119	121 162	25 /29	680 126	27 /29	897 116	22 /28	1750 114	20 /27	3414 116	23 /25

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 1991.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO APRIL 1992

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Nov	Dec	Jan	Feb	Mar	Apr	1991 Apr
					(%)▲					
North West	Northern Command Zone[1]	(G)	133375	41	72	79	70	80	94	93
	Vyrnwy	(R)	55146	82	85	95	86	88	100	99
Northumbria	Teesdale[2]	(G)	87936	41	68	88	88	89	96	93
	Kielder	(R)	199175*	85*	96*	99*	91*	94*	92	92
Severn-Trent	Clywedog	(R)	44922	75	82	87	88	85	99	95
	Derwent Valley[3]	(G)	39525	32	46	84	94	92	100	97
Yorkshire	Washburn[4]	(G)	22035	28	48	65	77	83	90	99
	Bradford supply[5]	(G)	41407	37	70	86	90	94	99	98
Anglian	Grafham	(R)	58707	76	81	88	90	88	95	85
	Rutland	(R)	130061	63	63	63	67	71	74	78
Thames	London[6]	(G)	206232	57	71	75	81	88	91	89
	Farmoor [7]	(G)	13843	89	97	99	99	97	84†	95
Southern	Bewl	(R)	28170	54	58	58	58	54	62	64
	Ardingly	(R)	4730	81	85	88	92	89	100	100
Wessex	Clatworthy	(R)	5364*	59*	89*	87	88*	82*	82*	100*
	Bristol WW [8]	(G)	36620	39	50	53	58	65	71	91
South West	Colliford	(R)	28540	79	83	83	82	81	80	92
	Roadford	(R)	34500	81	86	85	85	87	89	94
	Wimbleball[10]	(R)	21320	57	69	73	76	77	79	82
	Stithians	(R)	5205	34	34	37	38	45	52	100
Welsh	Celyn + Brenig	(G)	131155	71	84	94	93	97	100	100
	Brianne	(R)	62140	89	100	100	97	100	100	100
	Big Five[11]	(G)	69762	73	87	93	93	92	97	95
	Elan Valley[12]	(G)	99106	90	94	94	91	100	100	100
Lothian	Edinburgh/Mid Lothian	(G)	97639			95	92	96	100	99
	West Lothian	(G)	5613			90	82	91	94	94
	East Lothian	(G)	10206			95	98	98	99	98

† Decrease in Farmoor storage due to intake closure for engineering works

● Live or usable capacity (unless indicated otherwise)

* Gross storage/percentage of gross storage

▲ Percentage of live or usable capacity at or close to the beginning of the month according to data availability (unless indicated otherwise)

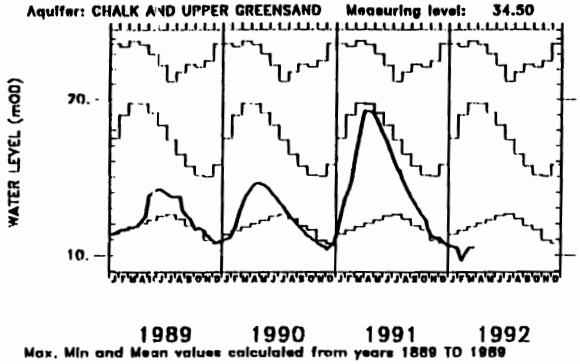
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. 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. The new Roadford reservoir was still filling after impounding.
10. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
11. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
12. 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 elsehwere in the report and the water resources situation.

FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

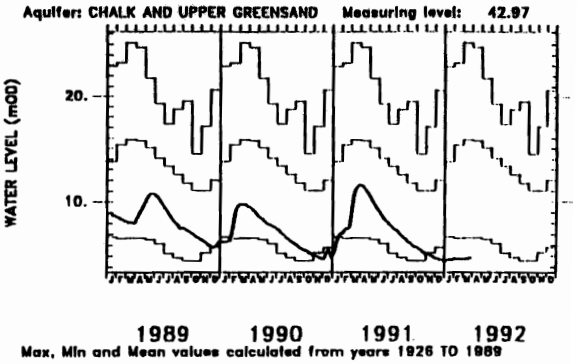
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 34.50



Max, Min and Mean values calculated from years 1889 TO 1989

Site name: LITTLE BROCKLESBY

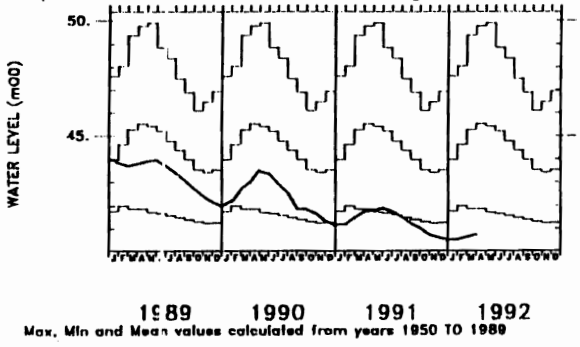
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 42.97



Max, Min and Mean values calculated from years 1926 TO 1989

Site name: WASHPIT FARM

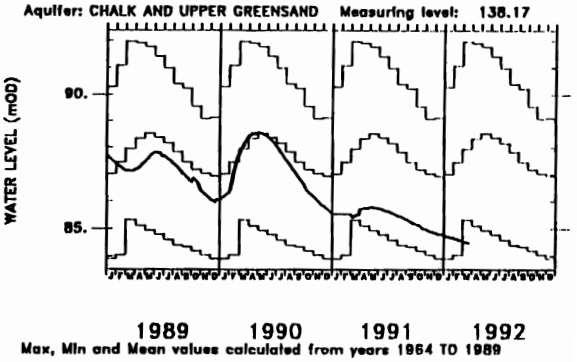
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



Max, Min and Mean values calculated from years 1950 TO 1989

Site name: THE HOLT

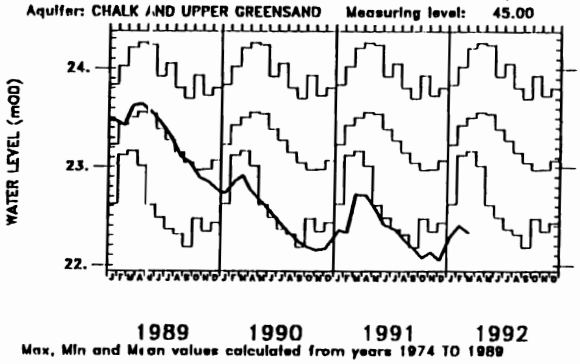
National grid reference: TL 1692 1965 Well number: TL11/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 138.17



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: FAIRFIELDS

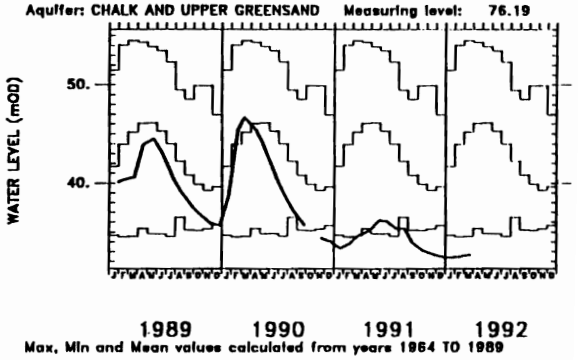
National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00



Max, Min and Mean values calculated from years 1974 TO 1989

Site name: REDLANDS HALL,ICKLETON

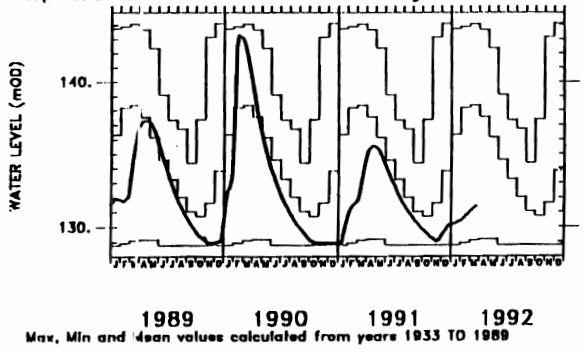
National grid reference: TL 4522 4182 Well number: TL44/12
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 76.19



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: ROCKLEY

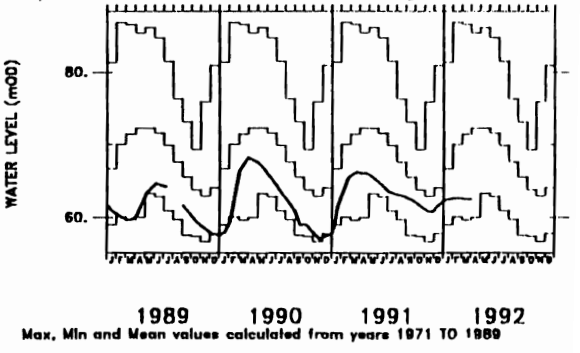
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.57



Max, Min and Mean values calculated from years 1933 TO 1989

Site name: LITTLE BUCKET FARM,WALTHAM

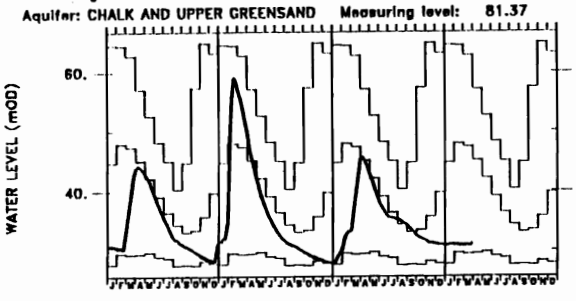
National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33



Max, Min and Mean values calculated from years 1971 TO 1989

Site name: COMPTON HOUSE

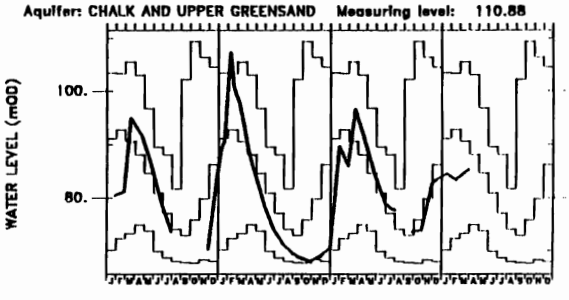
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



Max, Min and Mean values calculated from years 1894 TO 1989

Site name: WEST WOODYATES MANOR

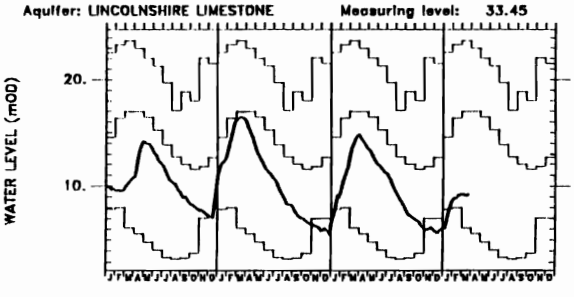
National grid reference: SU 0160 1960 Well number: SU01/5B
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.88



Max, Min and Mean values calculated from years 1942 TO 1989

Site name: NEW RED LION

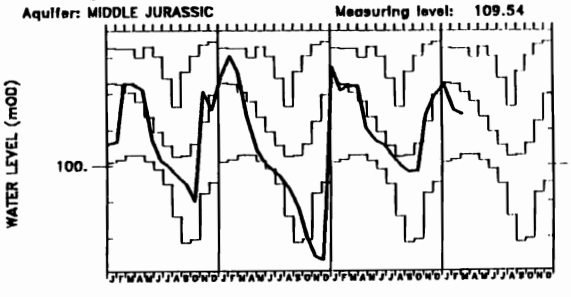
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.45



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

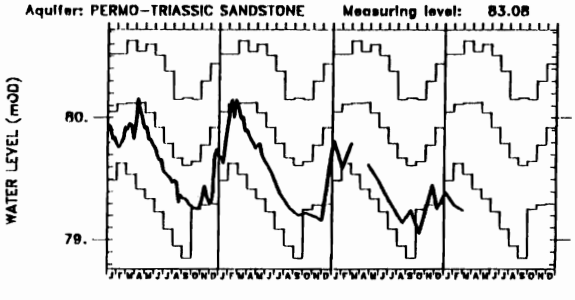
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.54



Max, Min and Mean values calculated from years 1958 TO 1989

Site name: LLANFAIR DC

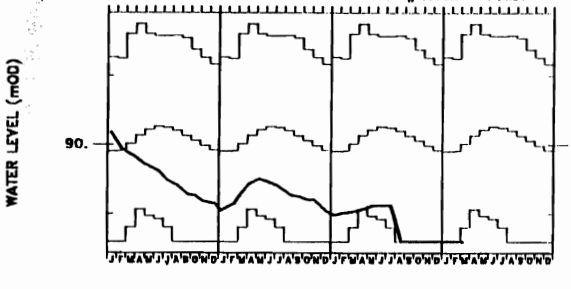
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 83.08



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: WEEFORD FLATS,WEEFORD

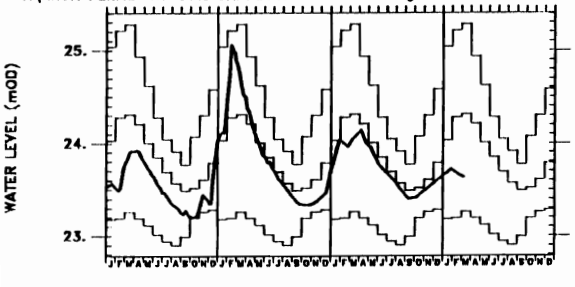
National grid reference: SK 1440 0464 Well number: SK10/9
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21



Max, Min and Mean values calculated from years 1966 TO 1989

Site name: BUSSELS NO.7A

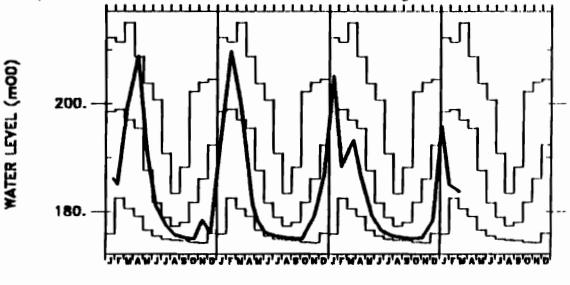
National grid reference: SX 9528 9872 Well number: SX99/37B
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.97



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: ALSTONFIELD

National grid reference: SK 1292 5547 Well number: SK15/16
Aquifer: CARBONIFEROUS LIMESTONE Measuring level: 280.25



Max, Min and Mean values calculated from years 1974 TO 1989

TABLE 5 A COMPARISON OF MARCH GROUNDWATER LEVELS : 1992, 1989 AND 1976

Site	Aquifer	Records commence	Average March Level	March 1976		March 1989		March and April 1992		No of years March levels <1992	Lowest pre-1992 level (any month)
				Day	Level	Day	Level	Day	Level		
Wetwang	C & UGS	1971	25.79	31/03	21.12	31/03	20.03	20/03	17.21	0	16.84
Dalton Holme	C & UGS	1889	19.75	27/03	14.30	30/03	11.82	24/03	10.44	0	10.34
Little Brocklesby	C & UGS	1926	15.85	11/03	6.98	30/03	8.04	27/03	4.76	0	4.56
Washpit Farm	C & UGS	1950	45.26	01/03	43.10	07/03	43.69	02/04	40.71	0	41.24
The Holt	C & UGS	1964	87.95	25/03	86.37	29/03	87.13	22/03	84.47	0	83.90
Therfield Rectory	C & UGS	1883	79.92	24/03	76.87	25/03	82.54	22/03	dry	6	dry (below 71.60)
Fairfields	C & UGS	1974	23.51	23/03	23.16	21/03	23.62	10/03	22.33	0	22.05
Redlands Farm	C & UGS	1964	45.20	01/03	38.70	22/03	40.56	23/03	32.62	0	34.04
Rockley	C & UGS	1933	138.40	28/03	129.17	19/03	135.36	22/03	131.36	2	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	71.45	03/03	66.31	22/03	59.67	30/03	62.45	1	56.77
Compton House	C & UGS	1894	47.53	25/03	30.12	29/03	42.75	29/03	30.93	2	27.64
Chilgrove House	C & UGS	1836	56.25	27/03	38.28	29/03	56.20	29/03	40.31	3	33.46
West Dean No 3	C & UGS	1940	2.20	26/03	1.57	27/03	1.57	27/03	1.49	4	1.01
Lime Kiln Way	C & UGS	1969	125.52	15/03	124.54	30/03	124.74	25/03	124.07	0	124.09
Ashton Farm	C & UGS	1974	69.62	03/03	64.67	15/03	68.17	30/03	68.00	2	63.10
West Woodyates	C & UGS	1942	90.61	01/03	73.18	21/03	94.80	30/03	85.20	8	67.62
New Red Lion	LLst	1964	16.99	26/03	6.14	28/03	10.68	24/03	9.20	2	3.29
Ampney Crucis	Mid Jur	1958	102.03	28/03	100.37	30/03	102.26	09/03	101.42	9	97.38
Dunmurry (NI)	PTS	1985	28.63	no	levels	27/03	28.67	27/03	28.43	5	27.47
Llanfair DC	PTS	1972	80.12	01/03	79.54	28/03	79.83	02/03	79.24	0	78.85
Morris Dancers	PTS	1969	32.60	25/03	31.98	14/03	32.48	09/03	32.04	2	30.87
Weeford Flats	PTS	1966	90.02	25/03	89.19	08/03	89.89	10/03	dry	0	dry (below 88.61)
Bussels 7A	PTS	1972	24.31	30/03	23.29	31/03	23.91	10/03	23.63	1	22.90
Rusheyford NE	MgLst	1967	76.18	30/03	65.80	27/03	75.81	03/03	74.63	>10	64.77
Peggy Ellerton	MgLst	1968	34.87	25/03	31.64	13/03	34.85	09/03	31.97	1	31.10
Alstonfield	CLst	1974	197.07	25/03	180.54	12/03	199.30	10/03	183.77	2	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 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS