ENGLAND AND WALES WATER SITUATION REVIEW 1988/89 - December

This report has been compiled in response to the request for information made by the Department of the Environment on the 19th January 1989. It is intended as a preliminary briefing note only.

RAINFALL

Table 1 gives the monthly rainfall totals for 1988 - as a percentage of the 1941-70 average - for England and Wales and the ten water authority areas; the data from July are provisional. Also shown are the rainfall totals for the year plus the accumulated totals from April to December and from August to December.

Annual precipitation in 1988, for England and Wales, was marginally above average with most regions registering totals within 5 per cent of their respective means. Some tendency for the higher percentage rainfall totals to favour the important reservoir gathering grounds in the west and north may also be recognised.

Rainfall distribution throughout the year was far from typical (see Figure 1). January and March were both very wet, the former especially so in the South East. The total precipitation over the January-March period ranks as the fourth wettest in the general England and Wales series which extends back to 1766. Hence, early in the year, the replenishment of reservoirs and aquifers was plentiful and the water resources outlook reassuring. Subsequently, rainfall totals were below the average for most of the ensuing months; July was an exception but the hydrological effectiveness of the abundant rainfall was limited by evaporative losses. Conditions became particularly dry from August as many of the rain-bearing low pressure systems followed a north-westerly track distant from the English Lowlands. The combined November and December rainfall total has less than one-third of the long term average for the Thames, Southern and Wessex water authority areas.

The April-December rainfall total for England and Wales is about 15 per cent below average. Over the same period significantly lower rainfall totals were recorded during the droughts of 1921, 1933, 1947, 1955, 1964 and 1975. Shortfalls exceeding 15 per cent for other nine-month periods have also been registered relatively recently - in 1972/73, 1975, 1976, 1978 and 1984. The August to December rainfall totals for certain of the water authorities may be expected somewhat less frequently. On the basis of the provisional rainfall figures, return periods of about 20 years may be ascribed to the five-month totals for the Thames and Severn-Trent areas with a slightly longer return period associated with the total for the Southern Water area. In assessing return periods, the inherent assumption of stable climatic conditions is one that needs, of course, to be treated with considerable caution.

RUNOFF

Whilst the overall runoff totals in most regions for 1988 are expected to closely approach the long term average both the range of flows experienced and their temporal distribution, were unusual. 1988 runoff conditions were characterised by very high - sometimes unprecedented - flow rates in late January and early February with spate conditions again obtaining in March. Subsequently, a sustained recession - interrupted by a few significant runoff events - continued into the late summer when, with some important exceptions - including the River Thames, river flows did not diverge greatly from the seasonal average. From a water resources viewpoint, the most significant aspect of the runoff distribution in 1988 was the absence of any substantial recovery in river flows as evaporative demands declined into the autumn. Over wide areas, especially in central and southern England, the limited autumn and early winter rainfall resulted in very meagre increases in river discharge and monthly flow rates showed a remarkable stability over a period when a strong seasonal upturn would normally be expected. By the end of the autumn, flows in lowland rivers were substantially below average except in a few catchments where the abundant recharge over the preceding winter continued to provide significant baseflow support; the River Mimram (Hertfordshire), for instance remained above the long term monthly average flow rate into November. With little discernible seasonality in river flows evident after July the contrast between runoff in the January - March period and the total for the remainder of the year became very marked.

Table 2 lists the 1988 runoff totals for seven rivers in regions of England and Wales where, by late December, some concern was being expressed in relation to declining river flows. Also given are the April-December and August-December runoff totals, together with their ranking, compared with the same periods from the preceding record. These runoff totals suggest that careful monitoring of the situation throughout the winter is warranted but, as yet, there is no cause for alarm - the rankings point to a notable but not remarkable situation. Table 3, which highlights the December mean flows, serves to emphasise the critical importance of the next two months - this applies with equal emphasis to the surface water and groundwater situations - before evaporation rates rise substantially in the late spring. Average flows in December (for the regions under consideration) were often below two-thirds of the long term average for the month; a few small rivers, draining predominantly impervious catchments, registered flow rates below 25 per cent of the December mean. The rankings given in Table 3 confirm that comparisons with the 1933/34 drought - arising out of the remarkably low England and Wales rainfall total for November and December (only 1933 was drier) - are inappropriate. Flows are currently about 2 or 3 times those experienced at the beginning of 1934. Figure 2 illustrates that, as yet, accumulated runoff totals for 1988 considerably exceed those associated with other notable drought periods this century. In addition, the more plentiful rainfall in the west allowed the storage in a number of major water supply and regulating reservoirs to approach capacity; by mid-January 1989, Lake Vyrnwy storage was 93 per cent of capacity and the Elan Valley system was overspilling. However, a more compelling similarity with 1975 may be recognised - the very limited hydrological effect of rainfall in the June - August period, especially in the South, allows a valid comparison to be made despite the contrasting nature of the preceeding summers.

GROUNDWATER

The drought of 1975-76 that affected not only the whole of the British Isles but extended to much of continental Europe became severe only after the exceptionally dry winter of 1975-76 when, within most of England and Wales, negligible recharge to aquifers occurred. Thus, by the end of the spring of 1976, when seasonal underground storage should have been at its peak, aquifer storage was already at a very low level.

Given the lack of autumn and winter rainfall the question now posed is whether a repetition of the 1975-76 drought is probable. The attached Figure XX shows the apparent areal distribution of the percentage of the annual mean recharge received by the country's aquifers up to the end of 1988, based upon information obtained from well hydrographs. The distribution is necessarily approximate since groundwater levels are available only from a limited number of sites. Nonetheless, eastern and southern England appears to have received no recharge, while that for central England seems to have been very much below average.

Figure XY shows well hydrographs from a number of groundwater level observation sites up to the end of 1988. For comparison, the hydrographs for the same sites for the period 1973-76 are also shown. Although many sites show groundwater levels well below the mean for the time of year, only at Dalton Holme (in the Yorkshire Chalk) has the groundwater level reached that of late December 1975.

OUTLOOK

January 1989 rainfall has been meagre so far and soil moisture deficits have yet to be fully satisfied in some regions. The establishment of a persistent high pressure system over Western Europe - implying dry and stable conditions in southern Britain - could give rise to a situation where water supplies may be placed under considerable stress if - as in 1976 - a spring/summer drought were to materialise. This stress would be most severe in those regions where the very limited groundwater recharge posed a threat to both pumped supplies and the sustaining of river discharge rates from baseflow.

TABLE 1 1988 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Apr–Dec	Aug–Dec	Nov–Dec
England and Wales	179	99	175	71	88	64	177	94	77	107	49	46	102	86	75	48
WATER AUTHORITIES																
North West	164	106	193	73	74	41	187	116	90	102	55	71	106	90	87	63
Northumbria	146	85	135	71	98	41	219	70	80	135	78	50	101	94	83	64
Severn Trent	185	96	179	71	86	80	180	83	70	95	48	48	102	85	69	48
Yorkshire	152	123	172	57	84	67	184	96	74	130	61	51	104	89	82	56
Anglia	208	79	185	75	100	78	170	67	71	100	58	41	102	84	67	50
Thames	211	83	148	67	86	79	160	76	74	103	38	25	96	79	63	31
Southern	233	91	163	87	76	36	141	63	65	108	34	24	93	70	59	29
Wessex	170	112	148	63	77	74	163	99	62	123	35	25	96	80	69	30
South West	177	117	165	76	89	69	121	121	68	127	41	41	98	79	80	41
Welsh	173	99	199	65	105	56	179	121	87	97	47	45	106	89	79	46

Note: July-December rainfall figures are provisional.
December rainfalls are crude MORECS figures.

FIGURE 1 ENGLAND AND WALES RAINFALL (OCT 1987-DEC 1988) AS A PERCENTAGE OF THE 1941-70 AVERAGE

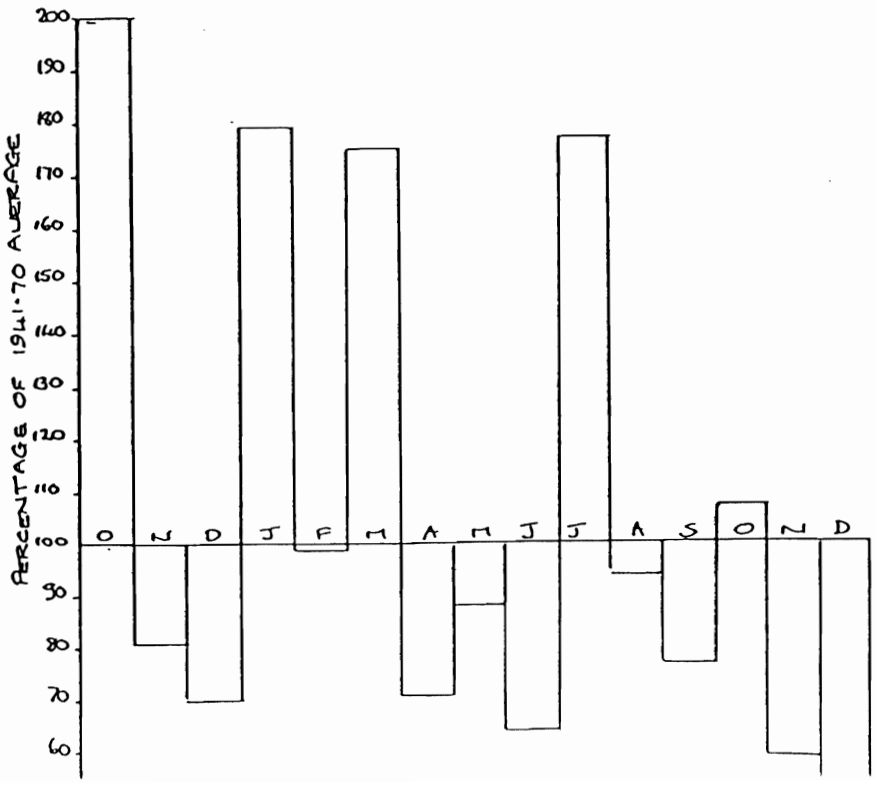


TABLE 2 1988 RUNOFF IN MM AND AS A PERCENTAGE OF THE LTA

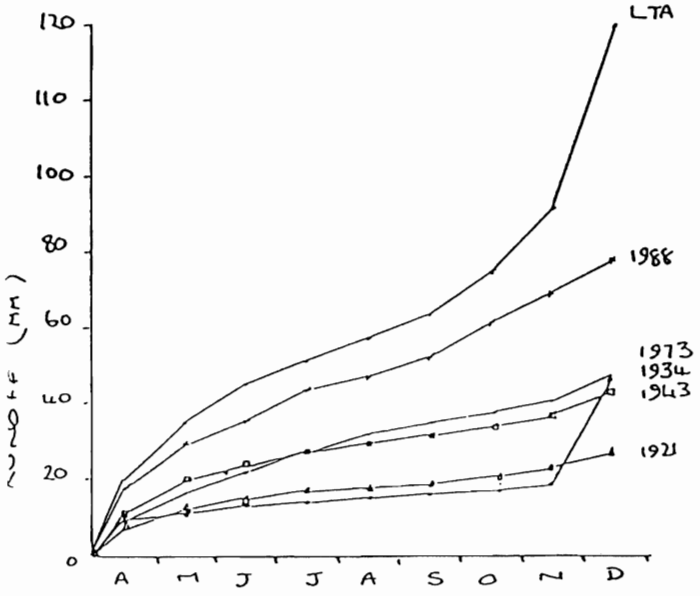
River/Station Name		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Apr–Dec	Rank	Aug–Dec	Rank
Thames at Kingston	mm	51	48	27	17	12	6	8	3	5	9	8	9	203	77	25/105	34	21/105
	%	150	160	96	89	80	60	133	50	83	90	42	32	96	65		51	
Coln at Bibury	mm	64	87	59	44	27	19	18	14	14	15	15	18	394	184	4/24	76	5/24
	%	123	164	109	100	79	68	82	82	93	88	60	44	99	75		66	
Kennet at Theale	mm	46	58	44	30	23	17	17	13	13	18	14	16	309	161	6/26	74	7/26
	%	135	171	116	94	85	77	100	81	93	113	70	59	105	85		80	
Itchen at Highbrdg	mm	49	66	61	50	42	32	31	25	24	27	27	27	461	285	6/29	130	3/29
	%	100	135	117	106	98	91	100	86	89	87	77	63	98	89		79	
Test at Broadlands	mm	32	42	41	32	26	21	21	18	18	20	20	20	311	196	7/27	96	6/28
	%	82	114	103	94	87	84	100	95	95	87	80	67	91	87		83	
Trent at Colwick	mm	77	54	63	24	22	16	28	16	17	23	17	29	386	192	8/29	102	8/29
	%	157	123	158	77	85	84	175	94	94	96	55	64	108	85		76	
Severn at Bewdley	mm	121	70	55	24	17	13	19	22	35	41	22	36	475	229	17/67	156	22/67
	%	173	121	120	77	71	72	136	122	159	121	41	57	105	82		82	

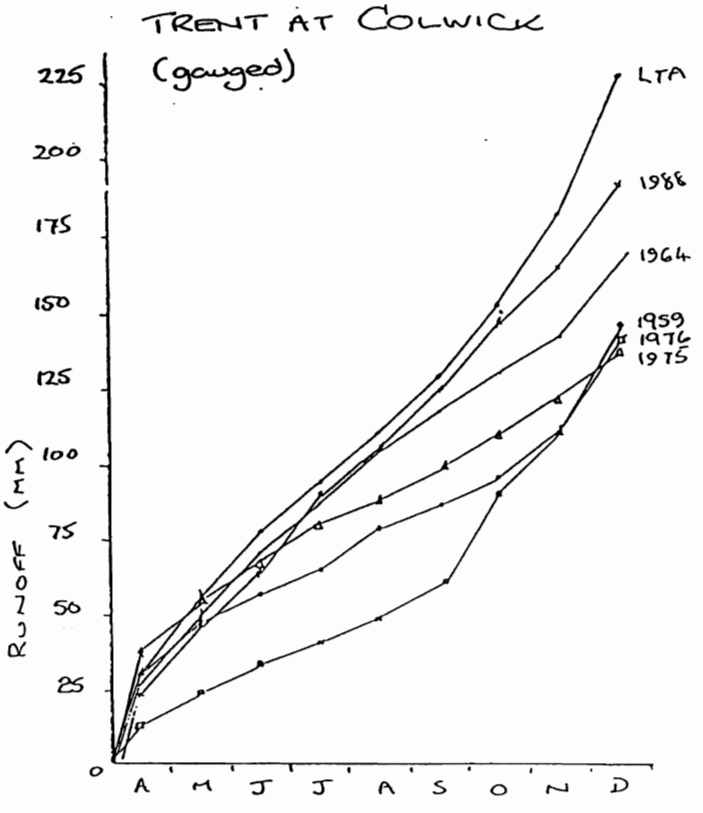
TABLE 3 RIVER FLOWS – DECEMBER 1988

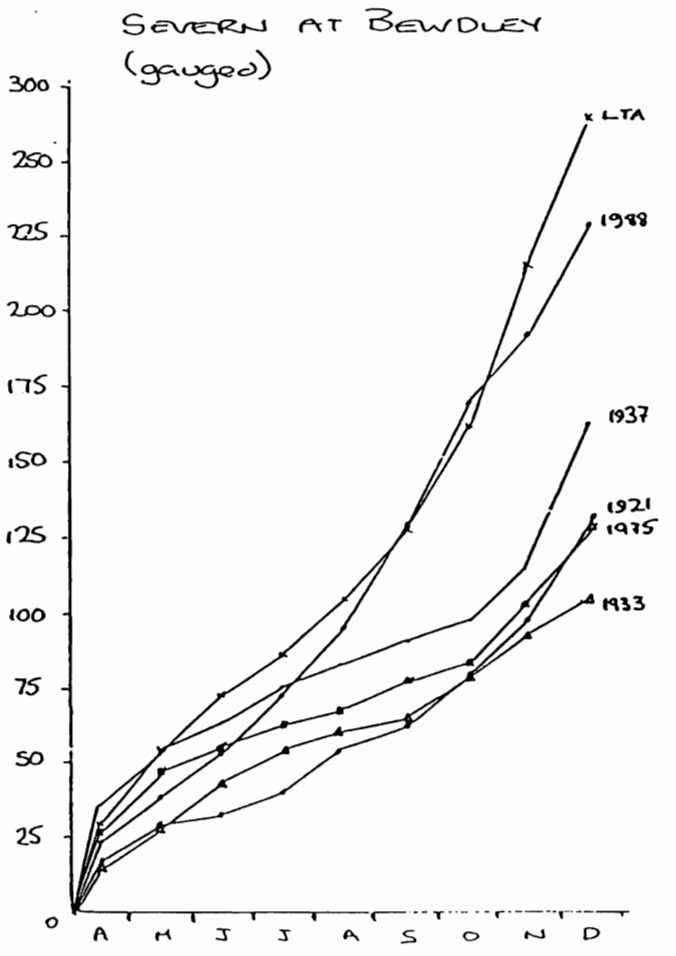
River/Station Name	POR	Mean Flow Dec 1988 (cumecs)	% of Ave	Rank	Dec Min/Year	Comment
Thames at Kingston	1883–1988	33.1	32	10	10.2 (1933)	Lowest Dec flows since 1975
Coln at Bibury	1963–1988	0.7	44	3	0.38 (1975)	Lowest Dec flows since 1975
Kennet at Theale	1961–1988	6.1	59	3	5.16 (1964)	Lowest Dec flows since 1975
Itchen at Highbridge	1958–1988	3.6	63	2	3.14 (1973)	
Test at Broadlands	1957–1988	7.8	67	3	6.07 (1973)	
Stour at Throop	1973–1988	8.2	36	2	6.39 (1975)	Dec 1987: 10 cumecs only
Trent at Colwick	1958–1988	80.0	64	5	46.3 (1975)	
Severn at Bewdley	1921–1988	58.0	57	8	17.8 (1933)	Dec 1987 flows lower than Dec 1988

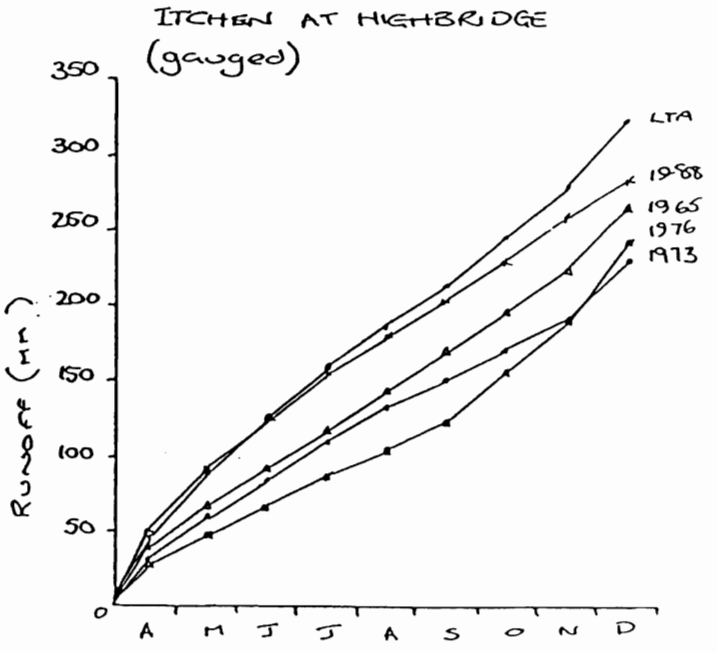
*Rank: Driest = 1

FIGURE 2 CUMULATIVE RUNOFF DIAGRAMS (APRIL TO DECEMBER) FOR SELECTED CATCHMENTS









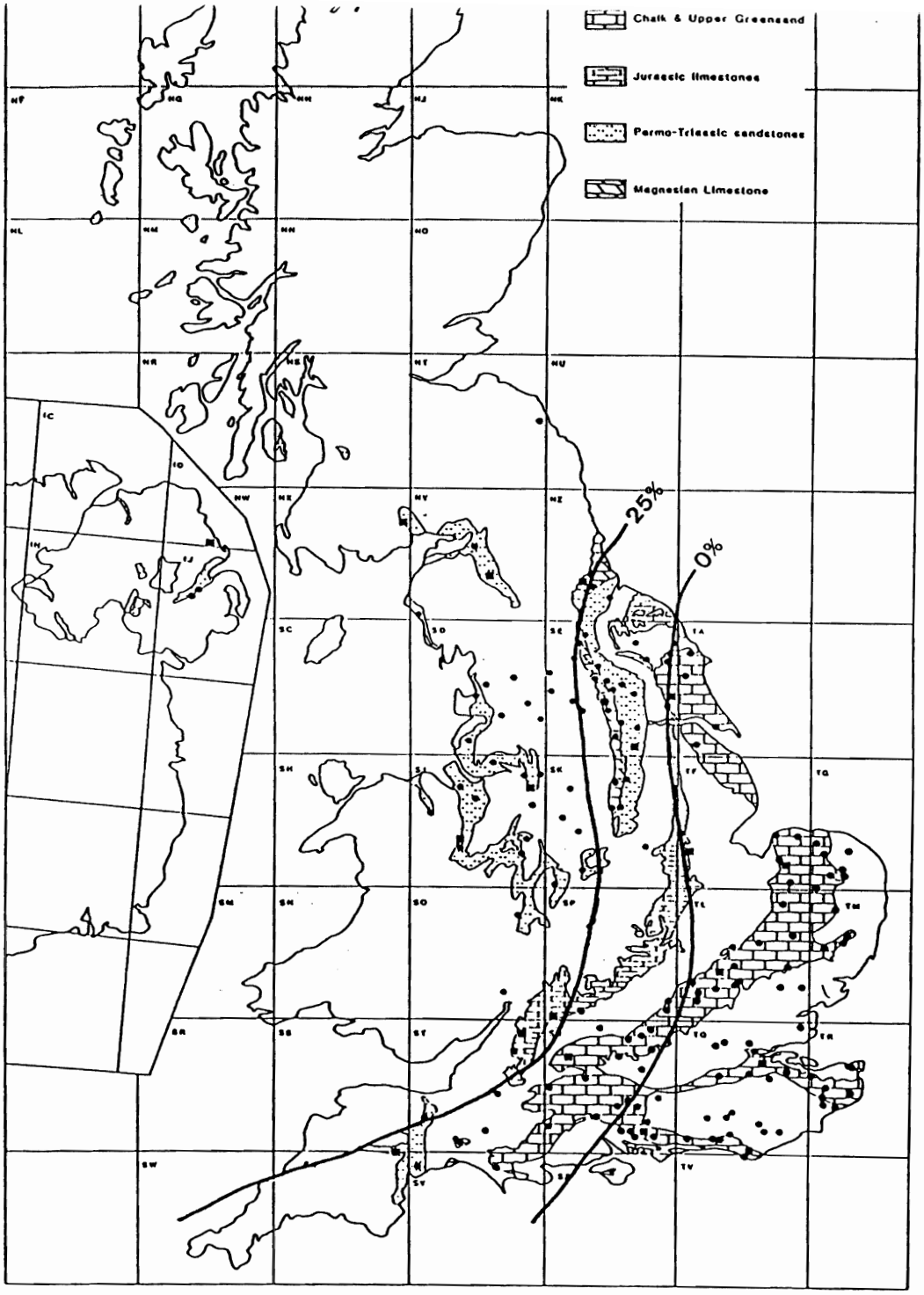
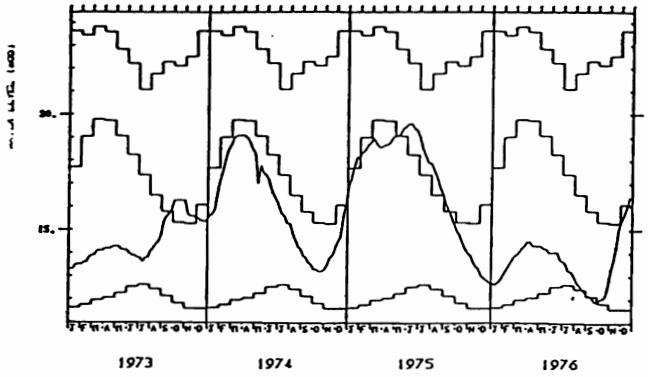


Figure XX. Areal distribution of the percentage of the mean annual recharge received by aquifers up to the end of 1988. Based on groundwater level observation well hydrographs.

Site name: DALTON HOLME

National grid reference: SE 9651 4530 Well number: SE94/5

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 33.50



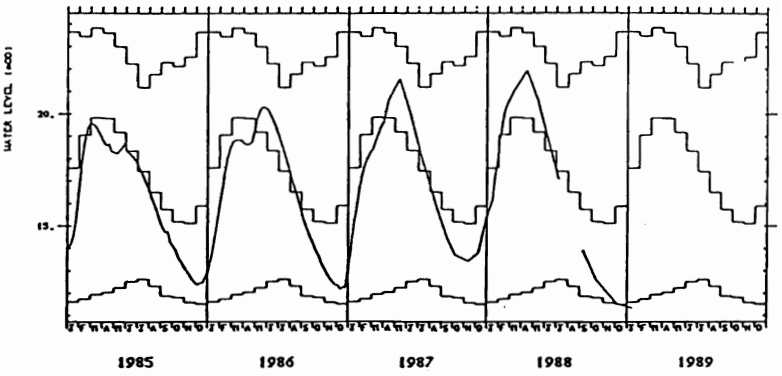
Max, Min and Mean values calculated from years 1889 TO 1975

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: DALTON HOLME

National grid reference: SE 9651 4530 Well number: SE94/5

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 33.50



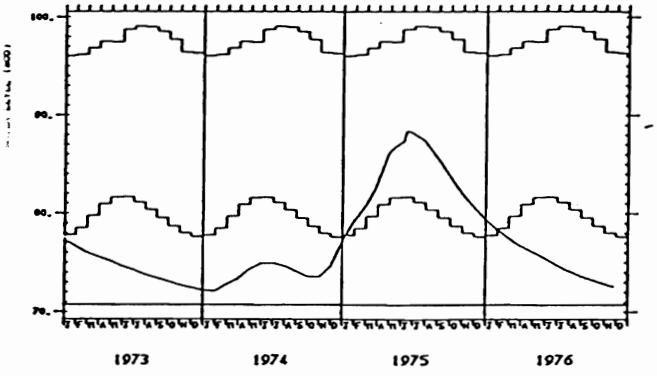
Max, Min and Mean values calculated from years 1889 TO 1988

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: THERFIELD RECTORY,THERFIELD

National grid reference: TL 3330 3720 Well number: TL33/4

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 154.82



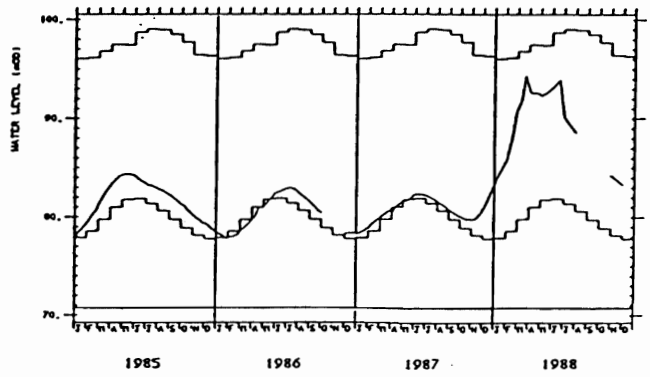
Max, Min and Mean values calculated from years 1883 TO 1975

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: THERFIELD RECTORY,THERFIELD

National grid reference: TL 3330 3720 Well number: TL33/4

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 154.82

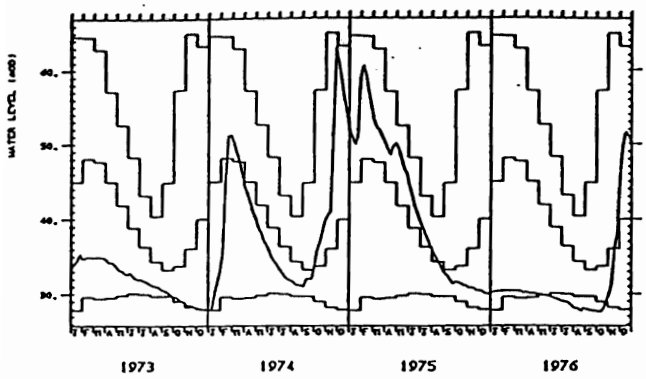


Max, Min and Mean values calculated from years 1883 TO 1987

Site name: COMPTON HOUSE

National grid reference: SU 7755 1490 Well number: SU71/23

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



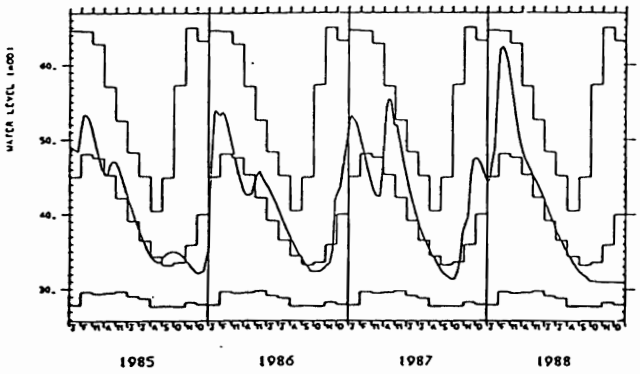
Max, Min and Mean values calculated from years 1893 TO 1975

A break in the data line indicates a recording interval of greater than 6 weeks

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 1987

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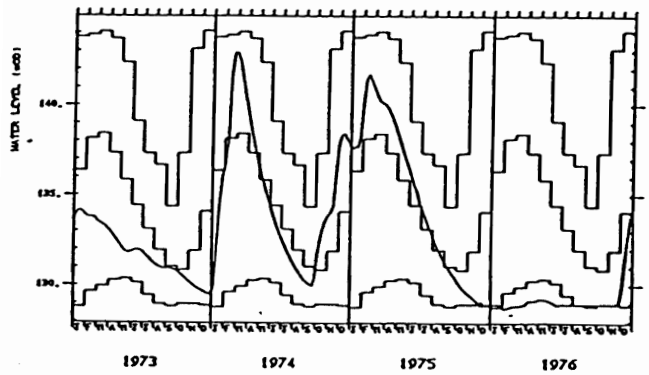
Site name: ROCKLEY

National grid reference: SU 1655 7174 Well number: SU17/57

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.39



Max, Min and Mean values calculated from years 1933 TO 1975

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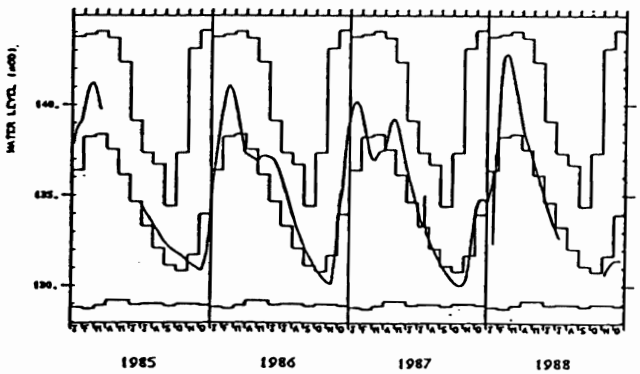
Site name: ROCKLEY

National grid reference: SU 1655 7174 Well number: SU17/57

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.39



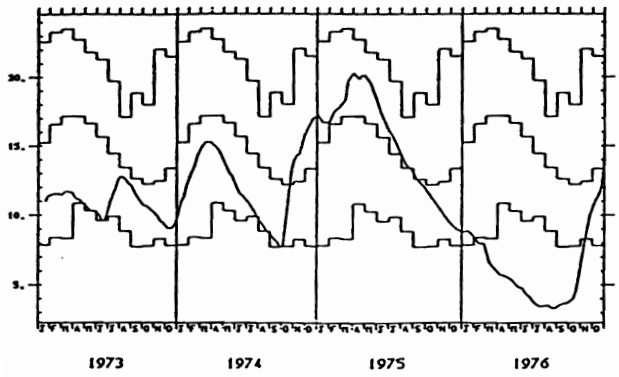
Max, Min and Mean values calculated from years 1933 TO 1987

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: NEW RED LION

National grid reference: TF 0885 3034 Well number: TF03/37

Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.82



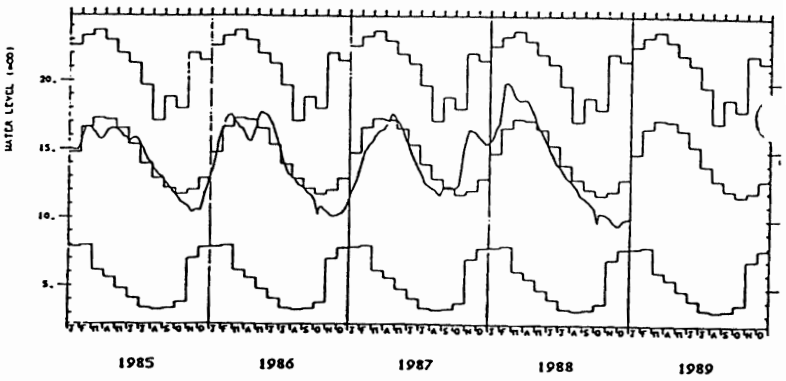
Max, Min and Mean values calculated from years 1964 TO 1975

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: NEW RED LION

National grid reference: TF 0885 3034 Well number: TF03/37

Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.82



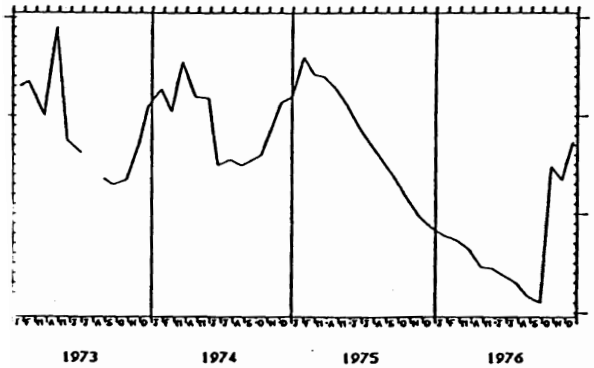
Max, Min and Mean values calculated from years 1964 TO 1988

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: PEGGY ELLERTON FARM,HAZLEWOOD

National grid reference: SE 4535 3964 Well number: SE43/9

Aquifer: MAGNESIAN LIMESTONE Measuring level: 51.40



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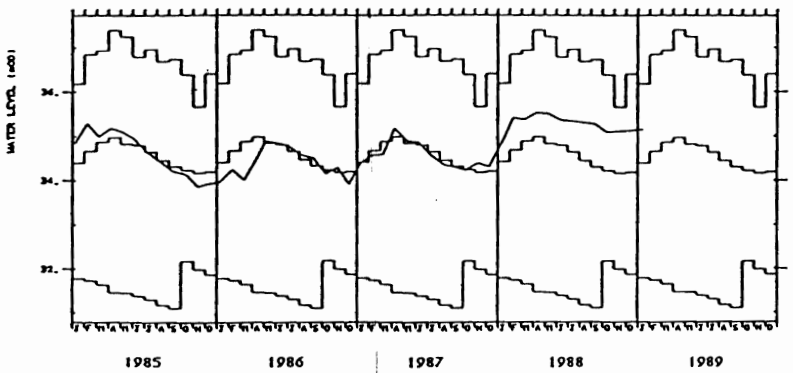


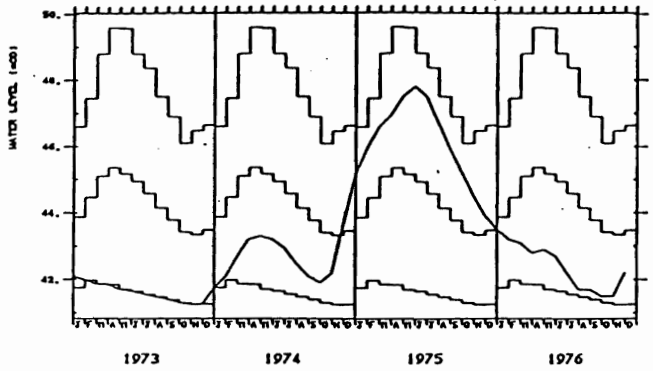
Max, Min and Mean values calculated from years 1968 TO 1988

A break in the data line indicates a recording interval of greater than 6 weeks

Site name, WASHPIT FARM

National grid reference, TF 8138 1960 Well number, TF81/2

Aquifer, CHALK AND UPPER GREENSAND Measuring level, 80.20



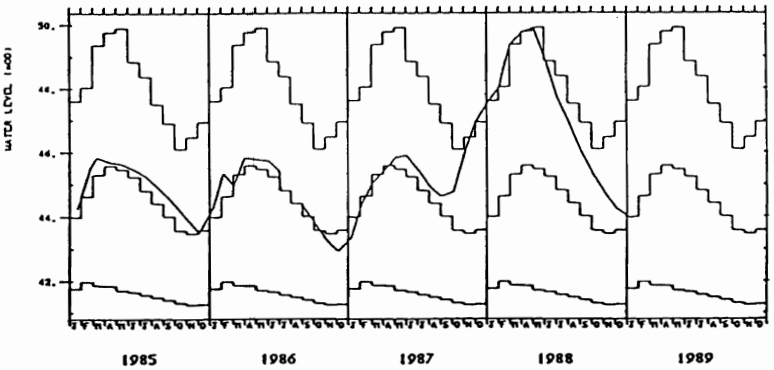
Max, Min and Mean values calculated from years 1950 TO 1975

A break in the data line indicates a recording interval of greater than 6 weeks

Site name, WASHPIT FARM

National grid reference, TF 8138 1960 Well number, TF81/2

Aquifer, CHALK AND UPPER GREENSAND Measuring level, 80.20



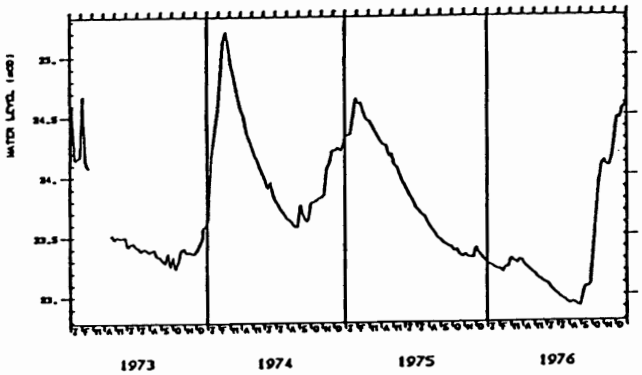
Max, Min and Mean values calculated from years 1950 TO 1988

A break in the data line indicates a recording interval of greater than 6 weeks

Site name, BUSSELS NO.7A

National grid reference, SX 9528 9872 Well number, SX99/37B

Aquifer, PERMO-TRIASSIC SANDSTONE Measuring level, 26.07



A break in the data line indicates a recording interval of greater than 6 weeks

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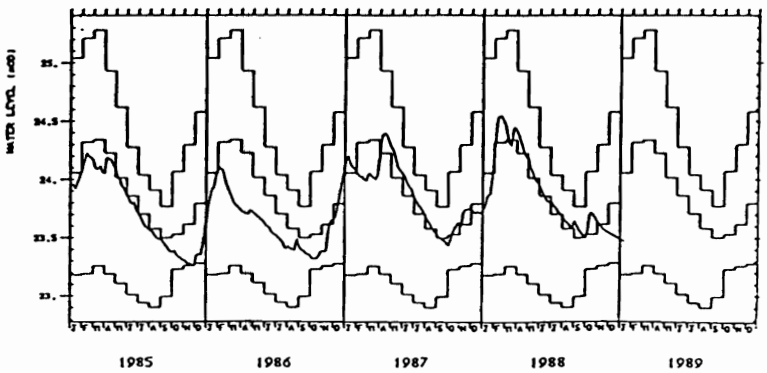
Aquifer, PERMO-TRIASSIC SANDSTONE Measuring level, 26.07



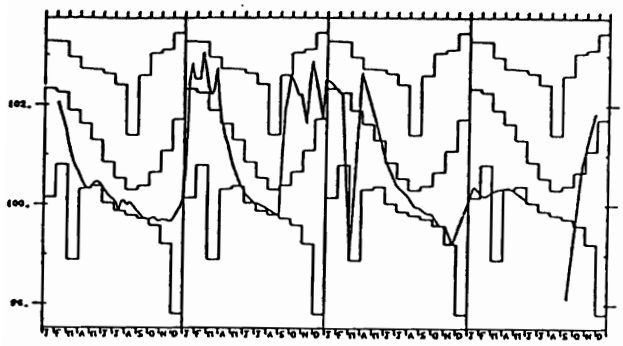
Max, Min and Mean values calculated from years 1972 TO 1988

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: AMPNEY CRUCIS

National grid reference: SP 0595 0190 Well number: SP00/62

Aquifer: MIDDLE JURASSIC Measuring level: 109.70



1973 1974 1975 1976

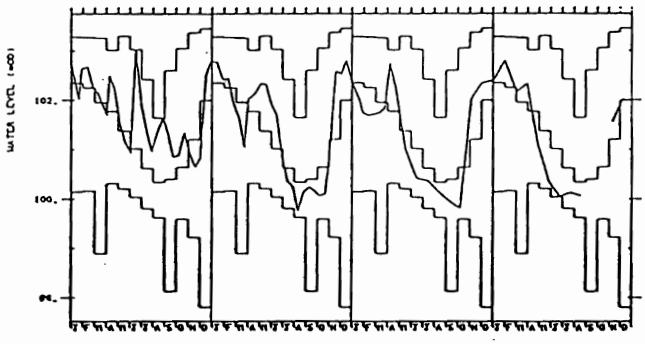
Max, Min and Mean values calculated from years 1958 TO 1975

A break in the data line indicates a recording interval of greater than 6 weeks

Site name: AMPNEY CRUCIS

National grid reference: SP 0595 0190 Well number: SP00/62

Aquifer: MIDDLE JURASSIC Measuring level: 109.70



1985 1986 1987 1988

Max, Min and Mean values calculated from years 1958 TO 1987

A break in the data line indicates a recording interval of greater than 6 weeks