HYDROLOGICAL SUMMARY FOR ENGLAND AND WALES
FEBRUARY 1989

This second report of 1989 presupposes that the background information presented in the January report has been assimulated. As before, data has been provided principally by the water authorites and the Meteorological Office, and much of the 1989 data may be subject to revision.

'AT A GLANCE'

At the end of January a winter drought was of concern in parts of central and southern England. The first two thirds of February saw the prevailing dry weather continue and the drought continue and intensify. The last 10 days of February were characterised by rainfalls which, in general, exceeded the February average and thus helped ameliorate the drought's effects. The distribution of this rainfall was such that the highest percentage falls occurred over upland areas which contain the major reservoirs. It appears likely that such reservoirs in Cumbria, the southern Pennines, Wales and the South West will be at, or close to, capacity.

The accumulated rainfall deficits at the end of February in the east, central southern and south east England are still significant; it remains unlikely that this situation will be fully corrected by the end of April. Some recharge of aquifers in these areas has now taken place but the groundwater levels are still, in many cases, close to those experienced in February 1976. Such conditions are likely to have a knock-on effect, later in the year, upon sources from aquifers of modest storage capacity and river abstractions from base flow fed rivers. In such areas, typical of ~~of~~ many areas of lowland England, the level of reservoir storage, which will be heavily dependent upon rainfall during the next six to eight weeks, will have a bearing on how effectively authorities can minimise supply shortfalls.

These affected areas are essentially rural and a good proportion will be under cultivation. It seems likely that there may be some restrictions on spray irrigation in the spring and summer; for these and other rural areas, it seems that amenity may also suffer with dried up headwater streams and springs and greater stress on aquatic life.

RAINFALL

Generally, the first two thirds of February saw a continuation of the stable weather pattern which characterised January and brought the anticyclonic conditions over central, southern and eastern England. The "blocking high", centred over the mainland of Europe became dissipated, although interruptions of the pattern, earlier in the winter, were short lived and the high re-established itself. Over the latter third some vigorous depressions to the north of Scotland brought a succession of Atlantic frontal systems and heavy rain over the majority of the UK; enough to promote flooding in Wales, Cumbria, the South West and parts of southern England. Conditions in Scotland were even more severe.

Table 1 gives monthly rainfall, both as total falls and expressed as percentages of the 1941-70 averages, together with accumulated totals from October and December. For these longer periods, the shortfall between the recorded totals and the long term average is given, both in mm and expressed as a percentage of the long term average. Judicious selection of accumulating periods would allow high rarity values to be demonstrated; the periods Oct-Feb and Dec-Feb have been chosen as typifying the time when rainfall would normally first begin to and then satisfy soil moisture deficits and infiltration to augment groundwater storage should be taking place. No water authority has received more than 90% of the long term average over these periods and the majority have recorded less than 67% The three and five month deficits have return periods of between 5 and 30 years for all but one of the RWA areas. However, with an eye to the statement above, and notwithstanding the recent abundant rainfall, the Nov-Feb rainfall remains the second driest this century (cf. Nov-Jan being the driest this century) behind 1933/34. Figure 1 illustrates 5 month rainfalls for England and Wales and five water authority areas most affected by shortfalls in rainfall.

Table 2 indicates the likelihood of making good the accumulated rainfall deficits over the next two months. For the two periods above, the percentage of average rainfall, together with its associated return period, required to wipe out the deficit is given for authority regions. These figures should be treated with a little caution as they represent only part of the water resources equation. The temporal distribution of winter rainfall is important because of the low evaporative demand in Nov-Jan; the further into the spring rainfall occurs, the less effective it is in augmenting resources, particularly subsurface ones. The likelihood of multiples of average rainfall occurring is greatest in those areas which normally receive the most. The areas most disadvantaged currently, therefore, have the lowest probability of making good the deficits. On the other hand, a lower percentage rainfall, albeit still above average, for the next two months would undoubtedly allay fears of a parallel situation to 1976 developing.

Nationwide or authority-wide rainfall figures mask some significant geographical differences in rainfall distribution. The West of England and Wales experienced February rainfalls well above average, upland areas of Wales and the North West receiving double average rainfall. Parts of the South West and central southern England had falls of over 150% of average. However, these high falls in parts of authorities like Southern and Severn-Trent were moderated by below average falls further east; parts of Kent and the Thames estuary had falls below 75% of average and the Lower Trent below 60% of average. When viewed with the perspective of the previous paragraph, these areas will have yet a lower probability of recovery from deficit.

SOIL MOISTURE DEFICITS

The February rainfall saw an appreciable diminution in the areas with oustanding deficits from 1988; the distribution of areas with deficits above 5mm is shewn in Fig. 1. The continuing deficits in the Humber area, Lower Trent and the Lincolnshire fens and the Thames estuary mirror the below average rainfall these areas recived in February. (The SMD figures, taken from MORECS, are for a notional grassland cover; estimates related to real land use would shew lower, but still appreciable deficits). These deficits are significantly higher than would normally be expected at the end of February (these would be the range 2 - 9mm for the areas shewn). Evaporation has certainly been above average owing to the generally mild temperatures; however, anticyclonic conditions have lower wind speeds associated with them and in the winter months, with a low transpiration demand, these quieter conditions would contribute to lessening evaporation - an interesting feedback effect.

The Lincolnshire deficits are associated with a region where PWS is heavily reliant upon two major aquifers; the Chalk and the Lincolnshire Limestone. Appreciable rainfall is thus still required in these areas before normal aquifer replenishment can begin.

RIVER FLOW

The recessions which were building throughout December and January continued into February; those rivers with a low baseflow component declining quite steeply and those with a high baseflow component continuing the slow recessions begun in the spring and summer of 1988. The response of rivers to the heavy rainfall towards the end of February was spectacularly different. Floods were experienced in Cumbria, Wales, the South West and in parts of central and southern England from those catchments of a relatively impermeable nature. Even the most sluggish of rivers had responded with an upturn by the end of the month, although this was not always reflected by the monthly figures.

Table 3 lists monthly runoff totals from October 1988 for a selection of representative rivers together with accumulated runoff from the periods Oct-Feb and Dec-Feb; an associated "driest" ranking is also given. Notwithstanding the high February rainfall in parts of central and southern England, many stations are recording only around 50% of average runoff, or less, for the three and five month accumulating periods. Of particular note is the 25% of average for Dec-Feb for the Sussex Ouse. Table 4 shews that the Itchen, the Sussex Ouse and the Yorkshire Derwent all recorded new February minima, the last by a considerable margin.

In general, however, February flows were not as rare as the January figures; the rapidly responding rivers in Wales shew complete recovery. Only the most reluctantly responding rivers are shewing delayed recovery, except in those areas where rainfall has been well below average. Table 4 illustrates flow rankings which have slipped compared to the January ones, for instance the Medway, Teise, Test, Kennet and Dorset Stour. Table 5 gives return periods for the probability of a February flow lower than Feb. 1989 for a selection of rivers; only Louth, on the Lincolnshire Wolds exhibits a rarer February than January flow. Were we able to examine other rivers in the areas with high SMDs we may find a similar picture. For example, the Idle, a right bank lower Trent tributary had a minimum February daily flow in which was easily the lowest recorded (in an admittedly short record). Other rivers were shewing minimum daily flows amoung the lowest recorded; the minimum flow on the Thames in February was about 8.5cumec, compared with the recorded monthly mean of 58cumec. The equivalent 1934 and 1976 figures were 12.8 and 7.1 cumec, respectively.

Other notable extremes were demonstrated in fast responding catchments in the Hampshire Basin; the rivers Lymington and Wallington recorded new February minima in the middle of the month but were the cause of flooding towards the end.

Figure 3 is provided as a location map for rivers in this report.

GROUNDWATER.

With effectively no rainfall in the first half of the month, rest water levels continued to fall in the observational wells, particularly in the eastern and southern lowlands and coastal districts of England. Following the late February rainfall, the erasure of soil moisture deficits over large areas has permitted infiltration and well hydrographs could be expected to shew an upturn in water levels. This is reportedly the case but the majority of well figures are from the middle of February; subsequent data are expected to confirm a modest upturn. The Compton well in the Sussex Chalk had seen a rise of 110mm by the beginning of March; levels in the well are very similar to those obtaining in 1976 (see Fig 4). New minima have been set in the Hamphire basin, although these levels are now responding to infiltration also. In Yorkshire, the Dalton Holme borehole is still at a new seasonal low; levels in the Lincolnshire Limestone and Norfolk Chalk appear to be well above historical lows.

Heavy rainfall may not lead to full translation into infiltration as the infiltration capacity may be overwhelmed, especially in those areas which have intermittent clay cover. The capacity for aquifer recharge is still of general concern; although infiltration is now possible, accelerating evaporative demand in the spring will lower effective rainfall. Assuming evaporation at the potential rate, some 60mm of rainfall will be lost during the next two months. Long term rainfall for March and April is 87mm in the Anglian WA area; 102mm in Thames; 117mm in Yorkshire and 103mm in Southern.

In major aquifers, the volume of storage is such that supplies from storage may be maintained. In shallower aquifers or those of otherwise modest storage spring infiltration will be critical.

TABLE 1 1988/9 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE TOGETHER WITH THE SHORTFALL RELATIVE TO THE AVERAGE

		Oct	Nov	Dec	Jan	Feb	Oct -Feb	% sf lta	Dec -Feb	% sf lta
		1988/89								
England and Wales	%	107	49	46	51	121	70	30	65	35
shortfall in mm		+6	49	49	42	+13	128		85	
England	%	111	51	44	48	117	71	29	65	35
	mm	8	44	45	40	+10	111		75	
Wales	%	96	48	54	37	135	40	60	102	2
	mm	5	78	70	156	+36	473		10	
WATER AUTHORITIES										
North West	%	102	55	71	61	152	84	16	88	12
		+2	54	34	44	+42	88		36	
Northumbria	%	135	78	50	40	106	81	19	63	37
	mm	+26	21	37	48	+4	76		81	
Severn Trent	%	95	48	48	51	121	70	30	70	30
	mm	3	41	36	24	+11	102		58	
Yorkshire	%	130	61	51	31	102	64	36	59	41
	mm	+21	35	36	53	+1	133		89	
Anglia	%	100	58	41	60	81	67	33	59	41
	mm	0	26	31	21	+8	86		60	
Thames	%	103	38	25	50	128	64	35	61	39
	mm	+2	45	50	31	+13	111		68	
Southern	%	108	34	24	38	109	59	41	52	48
	mm	+6	62	61	47	+5	158		102	
Wessex	%	123	35	25	52	151	70	30	67	33
	mm	+19	63	68	40	+30	122		78	
South West	%	127	41	41	50	150	76	24	72	28
	mm	+31	79	79	64	+45	146		98	
Welsh	%	97	47	45	59	146	76	27	76	24
	mm	4	76	80	56	+44	172		92	

Note: October 1988 - February 1989 rainfall figures are provisional. December, January and February rainfalls are based upon MORECS figures supplied by the Meterological Office.

TABLE 2 LIKELIHOOD OF MAKING GOOD ACCUMULATED RAINFALL DEFICIT BY THE END OF APRIL 1989

MARCH + APRIL	% M + A LTA LTA in mm	Return Period to make good OCT-FEB	% M + A LTA in yrs	Return Period to make good DEC-FEB	in yrs
England & Wales	117	209	1000	173	70
North West	149	159	25	124	< 5
Northumbria	107	171	40	176	50
Severn Trent	104	198	150	156	< 20
Yorkshire	109	222	800+	182	70
Anglian	80	208	300	175	40
Thames	92	221	400	174	30
Southern	100	258	1000+	202	150
Wessex	112	231	800	170	30
South West	155	194	120	163	30
WELSH	173	199	300	153	< 10

These return periods have been estimated from data provided by the Meteorological

Figure 1 Histograms of monthly rainfall for October 1988 to February 1989, expressed as a percentage of the long term average.

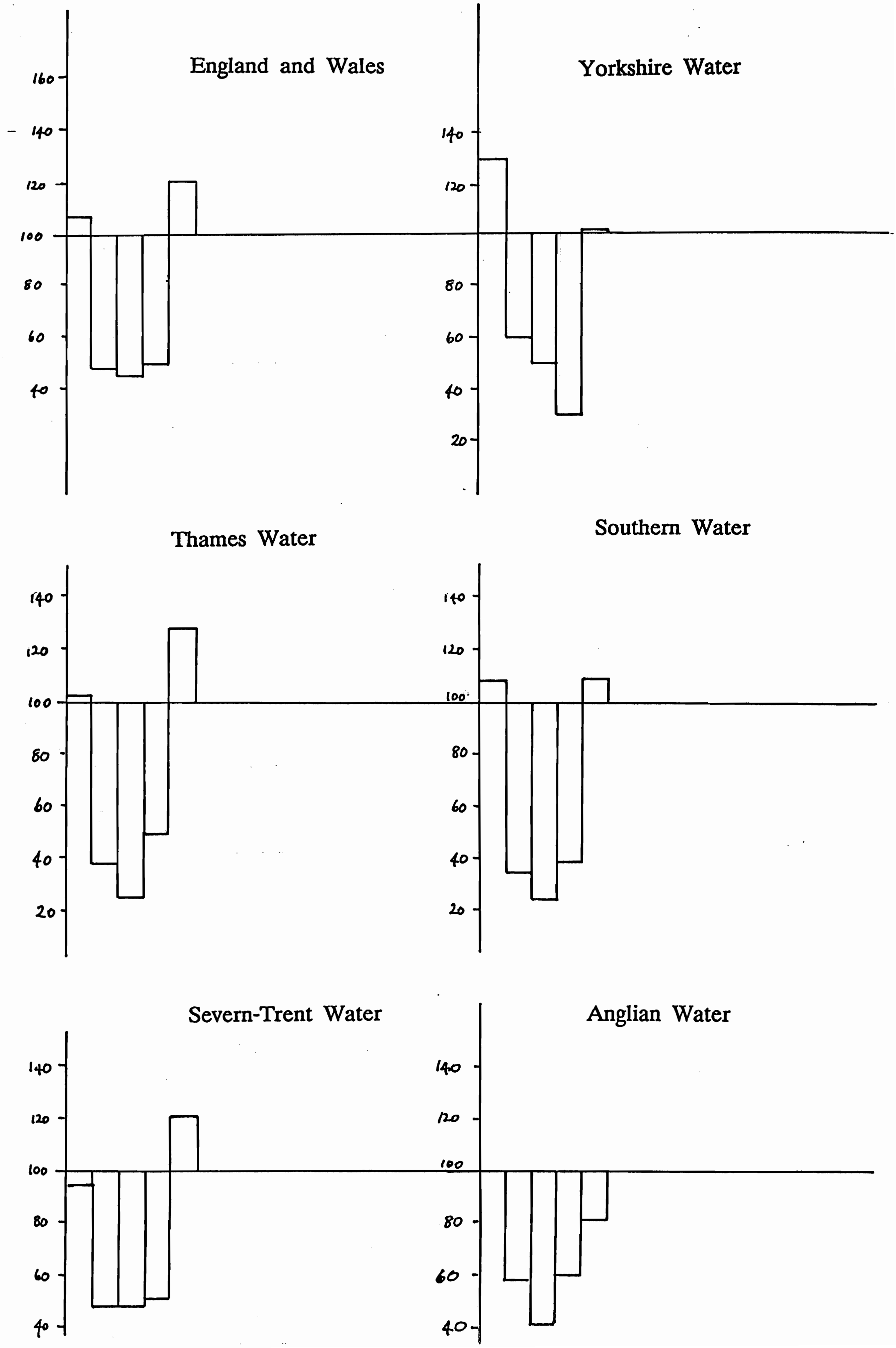


TABLE 3 CATCHMENT RUNOFF IN MM AND AS A PERCENTAGE OF LTA

River/Station Name		Oct 1988	Nov 1988	Dec 1988	Jan 1989	Feb 1989	Oct-Feb	Rank/No. of Yrs	Dec-Feb	Rank/No. of Yrs
Wharfe at Flint Ml	mm	80	65	81	42	64	332	7/32	187	4/32
	%	125	80	84	43	84	81		70	
Derwent at B'crambe	mm	22	21	29	17	17	106	1/26	63	1/26
	%	92	81	67	33	39	56		45	
Trent at Colwick	mm	23	17	29	21	26	116	3/30	76	4/30
	%	96	55	64	41	59	77		80	
Lud at Louth	mm	14	13	17	15	12	71	5/20	44	3/20
	%	117	87	85	48	33	63		52	
Witham at Claypole	mm	5	5	9	8	8	35	5/29	25	5/29
	%	56	42	47	31	28	38		35	
Ouse at Bedford	mm	11	9	18	13	23	74	11/55	54	9/55
	%	110	45	64	36	85	59		56	
Colne at Lexden	mm	9	8	11	13	14	55	9=/28	38	8/28
	%	100	62	65	59	74	71		66	
Thames at Kingston	mm	9	8	9	7	15	48	11/105	31	7=/105
	%	90	42	32	21	50	40		34	
Coln at Bibury	mm	15	15	18	15	19	82	2/25	51	3/26
	%	88	60	44	30	56	46		35	
Kennet at Theale	mm	18	14	16	16	19	83	3/27	53	2/27
	%	113	70	59	46	32	64		56	
Ouse at Gold Bridge	mm	13	10	11	8	12	54	1/27	31	1/27
	%	43	20	20	13	25	30		25	
Test at Broadlands	mm	20	20	20	20	20	100	3/30	60	3/30
	%	87	80	67	51	40				
Itchen at Highbrdge	mm	27	27	27	26	25	132	1/30	78	1/30
	%	87	77	63	53	46	64		55	
Stour at Throop	mm	25	13	20	19	28	105	2/15	67	2/15
	%	109	38	59	31	49	46		38	
Avon at Amesbury	mm	17	16	19	20	22	94	2/23	61	2/23
	%	106	76	58	45	49	66		55	
Tone at Bishops H	mm	42	20	26	25	54	167	2/28	105	3/28
	%	156	45	38	31	72	57		47	
Brue at Lovington	mm	76	21	25	32	52	206	3/24	109	2/24
	%	36	47	36	45	87	76		54	
Severn at Bewdley	mm	41	22	36	27	45	171	5/67	108	5/67
	%	121	41	57	38	64	61		57	
Yscir at Pont'yscir	mm	91	39	66	92	130	418	2/15	288	3/16
	%	98	28	43	64	123	68		71	
Cynon at Abercynon	mm	100	56	66	94	232	548	5/30	392	8/29
	%	82	36	34	51	184				

Figure 3 GAUGING STATION LOCATION MAP

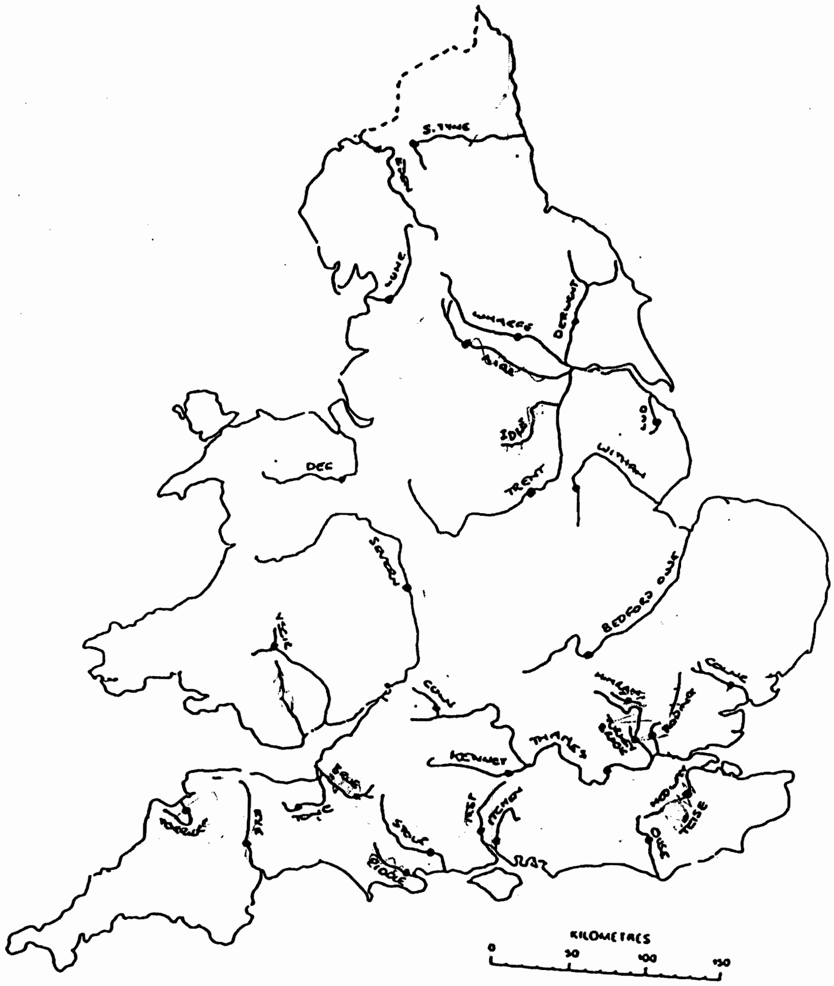
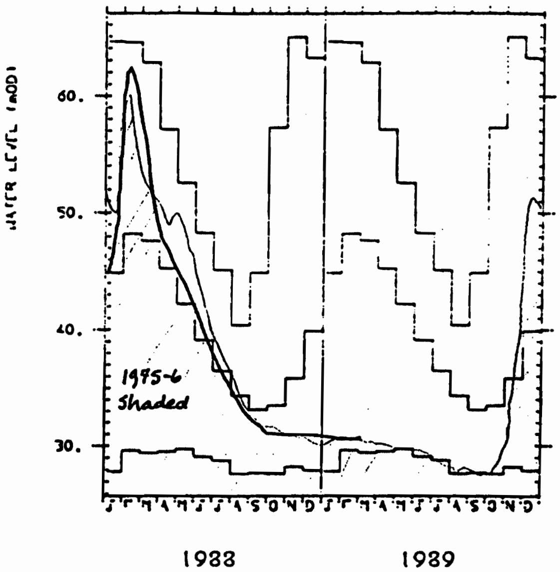


Figure 4 Observation Well Hydrographs

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

TABLE 4 RIVER FLOWS - February 1989

River/Station Name	POR	Mean Flow Feb 1989 (cumecs)	% of Ave	Rank	Feb Min/Year		Comment
Wharfe at Flint Mill	1937-1989	20.0	84	18	2.97	(1963)	
Aire at Kildwick	1968-1989	9.5	118	1	3.50	(1986)	
Derwent at B'crambe	1961-1989	11.0	39	1	11.0	(1989)	Compare 1982: 15.3
Trent at Colwick	1958-1989	80.2	60	6	49.98	(1976)	
Lud at Louth	1968-1989	0.27	50	3	0.16	(1976)	Compare 1973: 0.239
Witham at Claypole	1959-1989	0.93	28	5	0.49	(1976)	Similar to 1973
Ouse at Bedford Ouse	1933-1989	14.1	70	19	2.23	(1976)	
Colne at Lexden	1959-1989	1.32	73	11	0.35	(1973)	
Mimram at Panshanger	1952-1989	0.44	68	5	0.30	(1973)	Very high baseflow component
Thames at Kingston	1883-1989	58.0	47	20	12.31	(1976)	
" "	naturalised	79.9	59	26	25.1	(1905)	
Kennet at Theale	1961-1989	8.3	57	4	4.4	(1976)	Similar to 1963
Coln at Bibury	1963-1989	0.83	36	2	0.38	(1976)	
Medway at Teston	1956-1989	6.5	34	4	5.30	(1981)	Compare 1976: 6.19
Teise at Stonebridge	1961-1989	0.82	39	3	0.52	(1976)	Compare 1976: 0.52
Ouse at Gold Bridge	1960-1989	0.91	26	1	0.91	(1989)	Compare 1965: 1.24
Test at Broadlands	1957-1989	8.7	30	3			
Itchen at Highbridge	1958-1989	3.7	51	1	3.7	(1989)	Compare 1976: 4.21 & 1964: 4.2
Avon at Amesbury	1965-1989	2.92	49	3	1.19	(1976)	
Stour at Throop	1973-1989	12.5	50	3	6.83	(1976)	
Tone at Bishops Hull	1961-1989	4.51	73	11	1.7	(1965)	
Brue at Lovington	1964-1989	2.93	88	13	0.91	(1965)	
Severn at Bewdley	1921-1989	80.5	78	26	21.2	(1934)	
Yscir at Pontaryscir	1972-1989	3.39	124	12	0.998	(1986)	Fully recovered
Cynon at Abercynon	1957-1989	10.17	184	28	0.613	(1965)	Fully recovered
Dee at Manley Hall	1937-1989	37.25	82	20	7.9	(1963)	

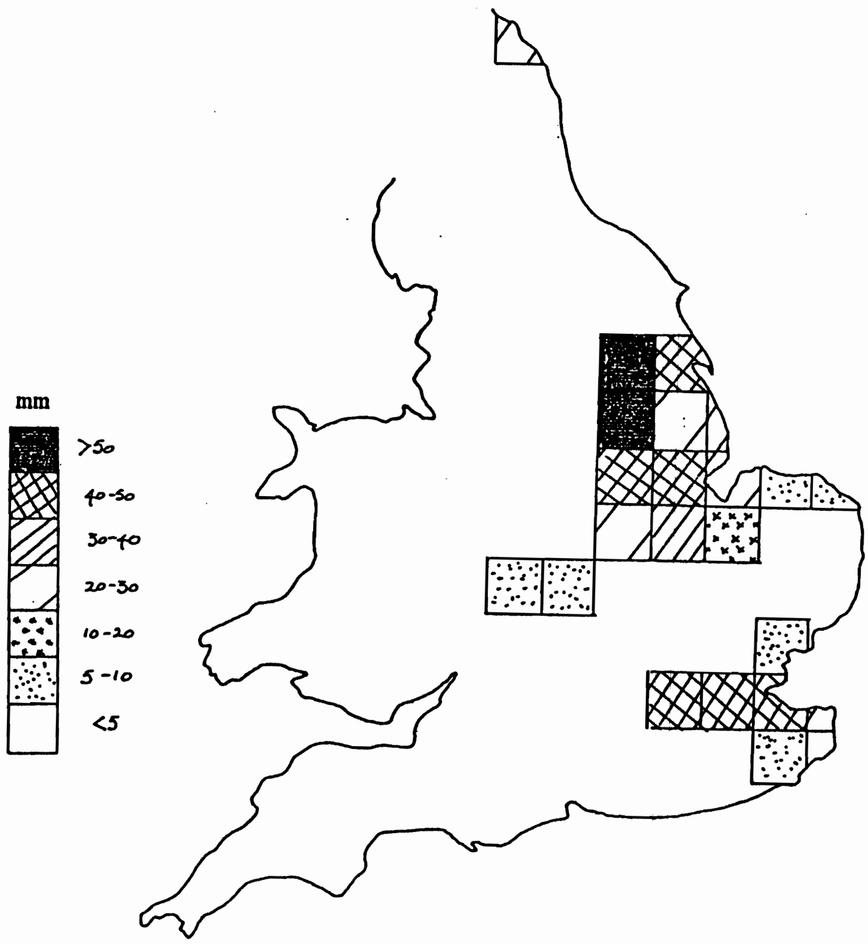
*Rank: Driest = 1

A significant proporation of 1989 flows are estimates.

Table 5 Return periods of February 1989 flows not being exceeded by another February flow. Return periods for January are also given.

Station	Hyd. Area	PoR	Feb 89 mn fl. (cumec)	%LTA	Return period (years) Feb	Jan
Trent at Colwick	28	59-88	80.2	60	5	25
Dove at Marston O D	28	62-88	17.9	89	2	
Lud at Louth	29	69-87	0.27	33	10	5-10
Witham at Claypole Mill	30	60-87	0.93	28	10	
Ouse at Bedford	33	33-87	14.1	70	2-5	5-10
Lee at Feildes Weir	38	37-88	4.64	69	2-5	
Mimram at Panshanger Pk	38	53-88	0.44	68	5	5
Thames at Kingston (nat)	39	1883-88	79.9	60	2-5	10-25
Kennet at Theale	39	62-88	8.3	56	5-10	10-25
Coln at Bibury	39	64-88	0.83	35	25	50
Medway at Teston	40	61-87	6.5	35	10	
Test at Broadlands	42	58-87	8.7	55	10-25	25-50
Itchen at Highbridge	42	59-87	3.7	52	25-50	50
Severn at Bewdley	54	22-88	80.5	79	2-5	10-25
Teme at Knightsford Bdge	54	71-88	17.5	54	5-10	
Yscir at Pontaryscir	56	73-87	3.4	131	<2	5
Cynon at Abercynon	57	58-87	10.2	186	<2	5

Figure 2 Soil moisture deficits over England and Wales at the end of February 1989. (Grass) Adapted from MORECS



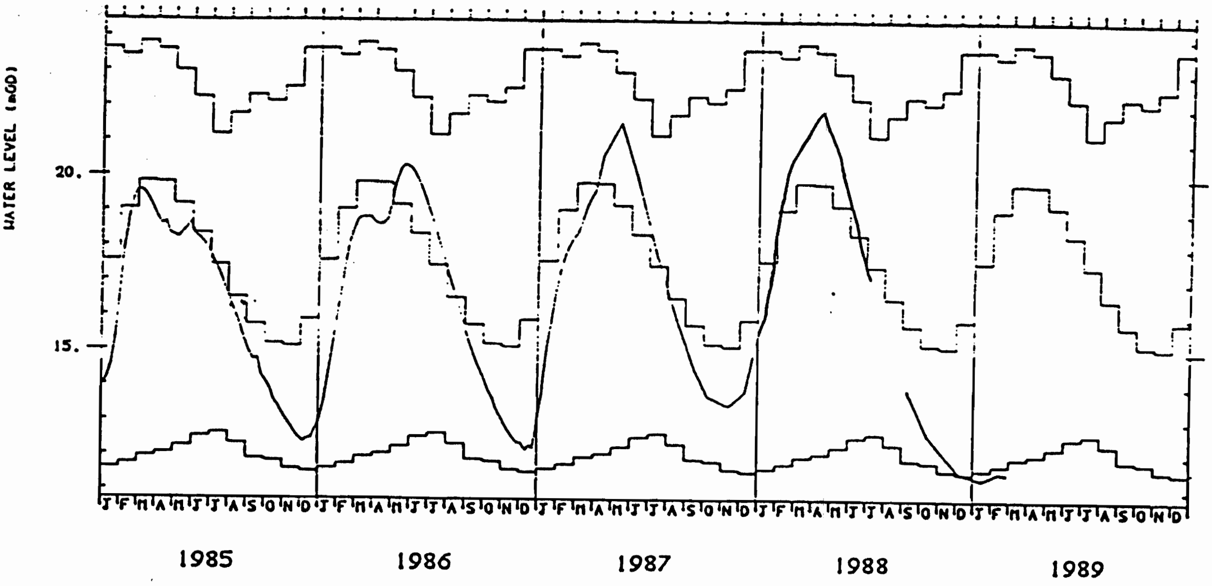
Site name: DALTON HOLME

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 8 weeks

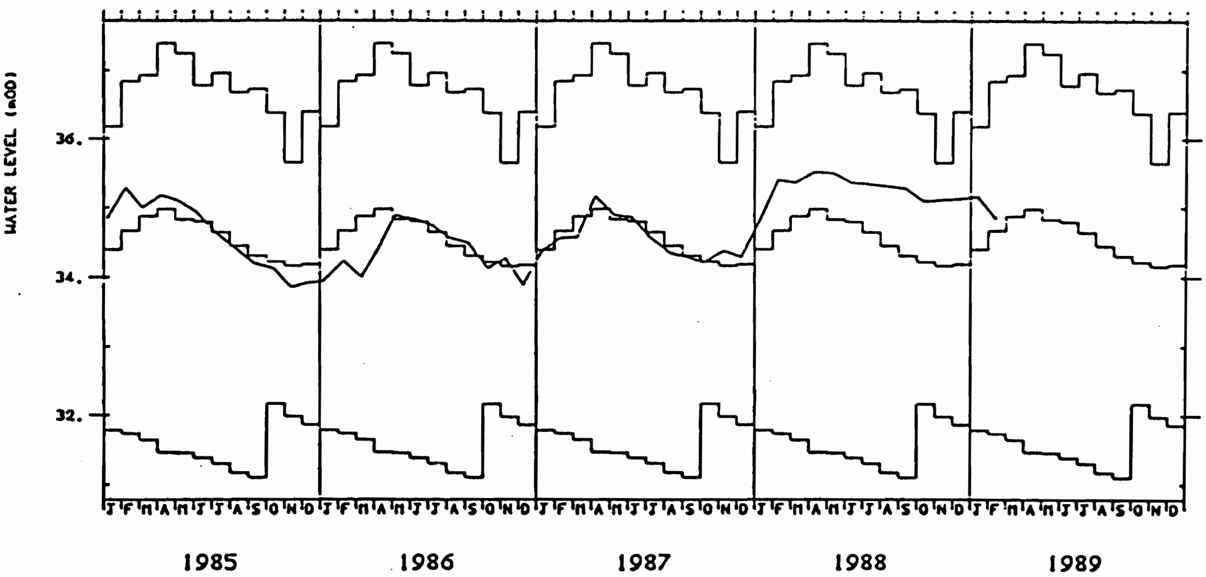
Site name: PEGGY ELLERTON FARM,HAZLEWOOD

National grid reference: SE 4535 3964

Well number: SE43/9

Aquifer: MAGNESIAN LIMESTONE

Measuring level: 51.40



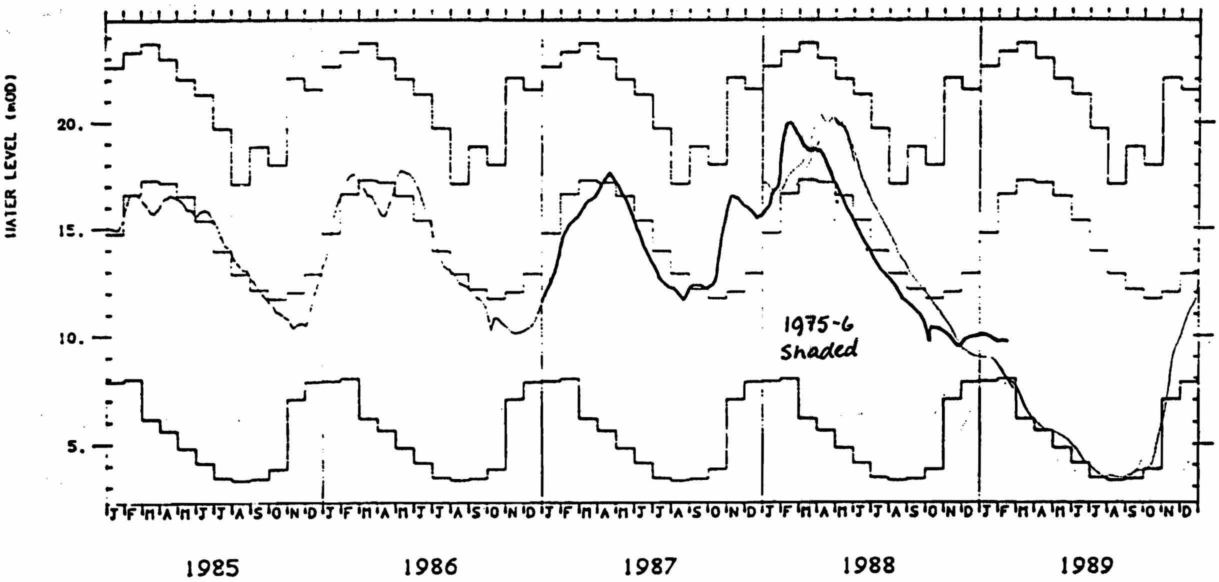
Max, Min and Mean values calculated from years 1968 TO 1988

A break in the data line indicates a recording interval of greater than 8 weeks

Site name: NEW RED LION

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

Aquifer: LINCOLNSHIRE LIMESTONE — Measuring level: 33.82



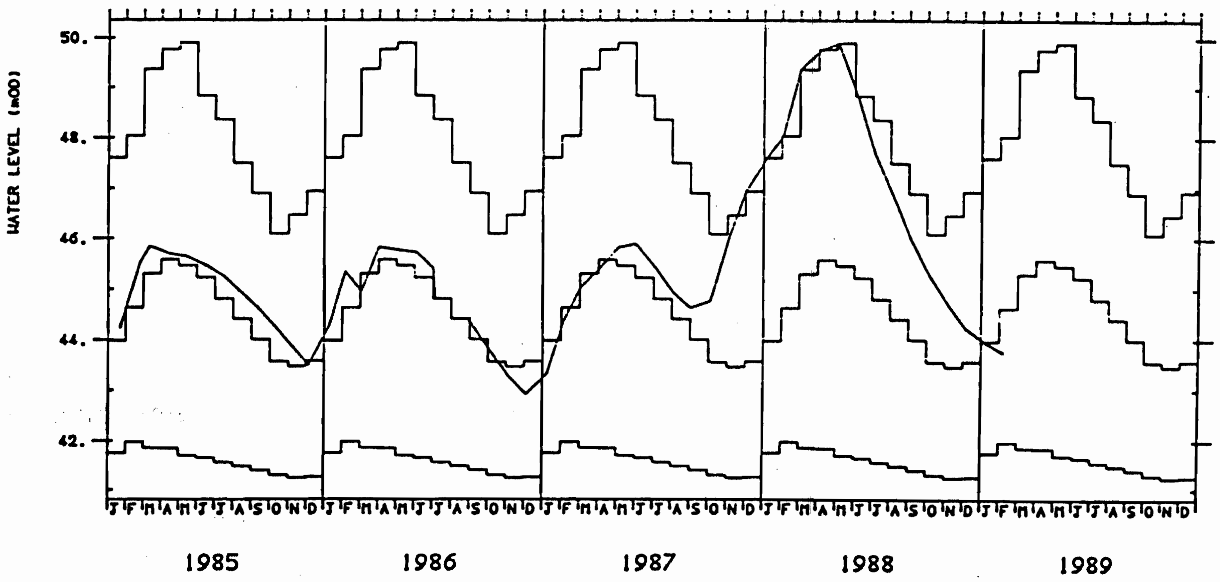
Max, Min and Mean values calculated from years 1964 TO 1988

A break in the data line indicates a recording interval of greater than 8 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 8 weeks