HYDROLOGICAL SUMMARY FOR ENGLAND AND WALES - JULY 1989

Data for this review have been provided, principally, by the regional Units of the National Rivers Authority and by the Meteorological Office.

A proportion of the featured data is of a provisional nature and may be subject to later revision. In particular, the areal rainfall totals derive from a limited raingauge network and, given the spatial variation which characterised the July rainfall, the figures quoted in this report should be treated with caution.

For a fuller appreciation of the water resources impact of the current drought, this hydrological review should be considered alongside assessments of the current reservoir storage situation in each region.

Summary

Precipitation in July, like June, was largely confined to the beginning and end of the month. In between, high pressure dominated most of England and Wales which enjoyed very hot and dry conditions. Evaporation losses were high and soil moisture deficits climbed steadily particularly in mid-month. Substantial rainfall deficits now exist in most areas; these deficits are most notable over the three and eight-month periods ending in July but, except in a few localities, the shortfalls do not compare with those obtaining in 1976. In runoff terms, rivers draining much of lowland England continued to benefit from baseflow support arising out of the late winter/early spring recharge; return periods in the range 5-10 years typify the July mean flows over wide areas but somewhat rarer flow rates characterise a number of districts. The limited July rainfall was associated with an especially rapid decline in flow rates in the West and North. In many regions July flows were the lowest since the 1984 drought; a few approached the flow rates registered during 1976. Although groundwater levels throughout the major aquifers are generally in a relatively steep seasonal decline they remain within the normal seasonal range albeit significantly below average in most areas. Only in the extreme south do they approach historical drought levels.

Water resources are relatively insensitive to summer rainfall - which has very limited hydrological effectiveness - but the prospect of rainfall in the latter part of the year similar to that of 1988 is one that will give rise to very real concern regarding the medium-term water resources outlook; certainly the impact of the current drought will be heavily influenced by the amount of autumn rainfall.

Review

The anticyclonic conditions which prevailed over much of lowland England for lengthy periods in May and June again dominated the July weather pattern. Showery interludes - with significant thundery activity in places - brought relief around the 6th and 7th and, again a fortnight later. For much of the month the weather was dry and exceptionally hot before a relatively cool north-westerly airflow became established on the 29th. Rainfall amounts varied greatly from place to place. Most of England and Wales, away from East Anglia, recorded less than 70% of the long term average but precipitation was significantly lower over a number of important reservoir gathering grounds. Whilst July was not notably dry, the England and Wales rainfall total since the beginning of May qualifies as the 4th driest this century.

Although the drought may broadly be categorised as a two-phase event separated by a wet interlude in the spring, the spatial and temporal variations in intensity are very marked. The magnitude of this variability may be appreciated by considering Table 2 which provides estimated return periods for England and Wales and the ten Water Authority regions for a selection of accounting periods. Such estimates assume a sensibly stable climate and should therefore be interpreted with caution. Nonetheless a significant

rainfall deficit may be recognised - in all regions - commencing in November 1988. A notable long term drought is evident in the Southern Water region (where it is more severe in East Sussex and Kent) and intense three-month droughts have developed in the South West, Wales and in Northumbria.

Soil Moisture Deficits increased throughout July, most noticeably away from the English lowlands. By month-end most areas registered SMDs greater than 100 mm and, in the North and West, deficits exceeded the late-July average by more than 50 mm. Over wide areas the SMDs are broadly similar to those experienced during the 1984 drought and, notwithstanding the rainfall recorded since the 9th August, their magnitude serves to emphasise the need for abundant autumn rainfall in order to replenish reservoirs and sustain river flows.

Geological control over low flow behaviour was as important as the limited rainfall in influencing July runoff rates. Rivers benefiting from little or no natural storage within the catchment registered monthly runoff totals around one third, or less, of the long term average reflecting the steep recessions which, with minor interruptions, have extended over three months or more. In the South West, where river flow return periods of twenty years in some catchments confirm the existence of a notable hydrological drought, concern has been expressed regarding the health of the aquatic environment. Flows of a broadly similar rarity were also recorded in northern England. In the English lowlands a rather complex picture emerges. Flows increased in a few East Anglian rivers during July and for many streams with substantial baseflow support the return periods (see Table 4) are unremarkable. However, rivers draining from both Chalk and from relatively impervious catchments in the Southern Water area registered extremely low flows at the end of July.

Monthly runoff totals (for July) are generally the lowest since 1984 or, more rarely, since 1976. However the last 13 years have been somewhat wetter than average and the intensity of the hydrological drought is less marked when considered in the perspective of the longer flow records; this is reflected in the return periods given in Table 4. Thus, although the July runoff for the Thames has been exceeded on more than 25 occasions since 1883, the 1989 total remains the second lowest (after 1976) in the last 35 years. Accumulated runoff totals since last October are generally well below average but a matter of major concern in only a few catchments. The Itchen, for instance, has remained below average for 15 consecutive months - there is only one longer such sequence within the flow record - and the accumulated runoff total over the last year only modestly exceeds the corresponding figure for 1975/76.

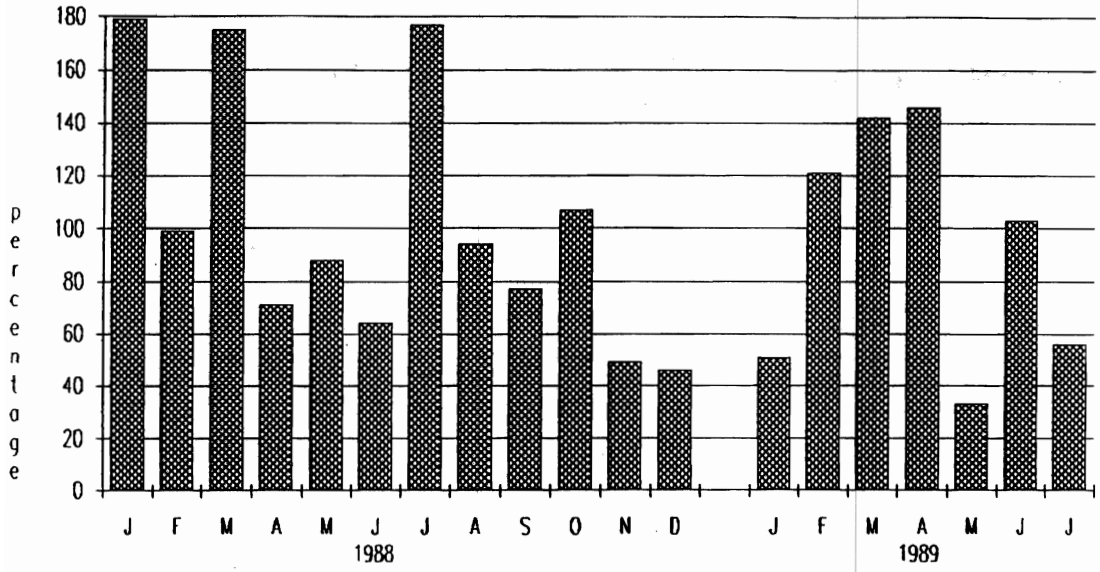
Under normal circumstances, no recharge is received by aquifers in England and Wales through the month of July. Consequently groundwater levels have continued to fall through the summer period. The decline has been rather steeper than in a normal year and groundwater levels in almost all aquifers are below - often substantially - the july mean. Nonetheless, where levels are unaffected by abstractions, levels generally remain well above the minimum on record; a reflection of the limited but late 1988/89 recharge in most areas. Away from Sussex and Kent many boreholes in the Chalk are not greatly below average and even at Dalton Holme in the Yorkshire Chalk, where unprecedented low levels were registered early in the year, the recession is following a trace significantly above the 1976 line; nonetheless the July level represents the lowest, for the month since the Great Drought.

No upturn in groundwater levels may be expected until the onset of the winter recharge which normally occurs in late September or early October. Lack of surface water may lead in places to heavier abstraction of groundwater, when this is available, and this may, in turn, lead to an increase in the groundwater level recession rate. However unless the onset of the winter recharge is delayed until late December, groundwater levels are unlikely to approach the recorded seasonal minima.

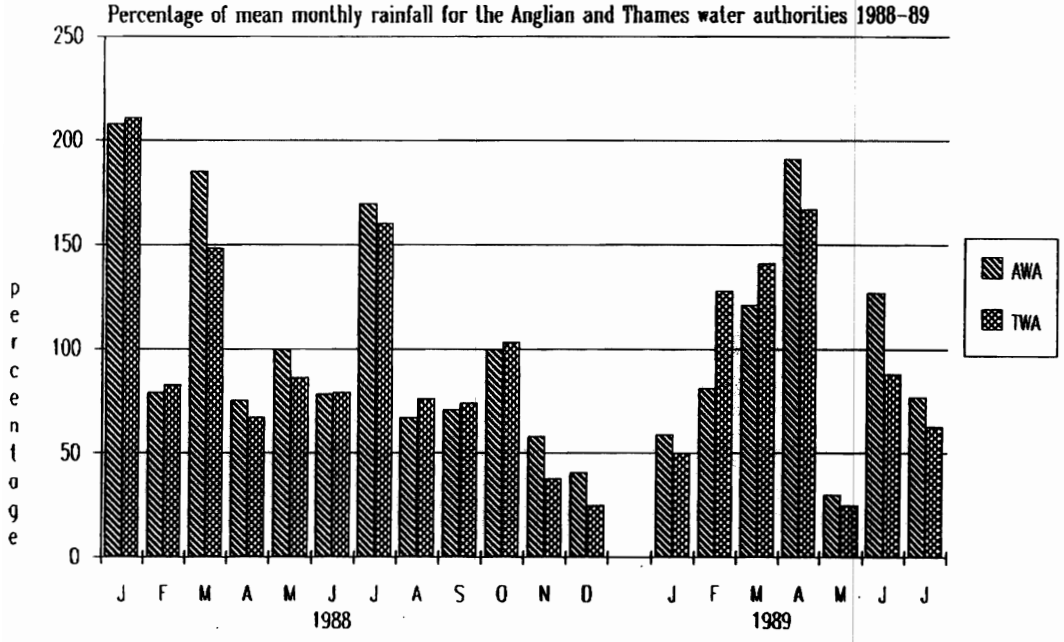
IH/BGS 11 August 1989

MONTHLY RAINFALL - JANUARY 1988 TO JULY 1989

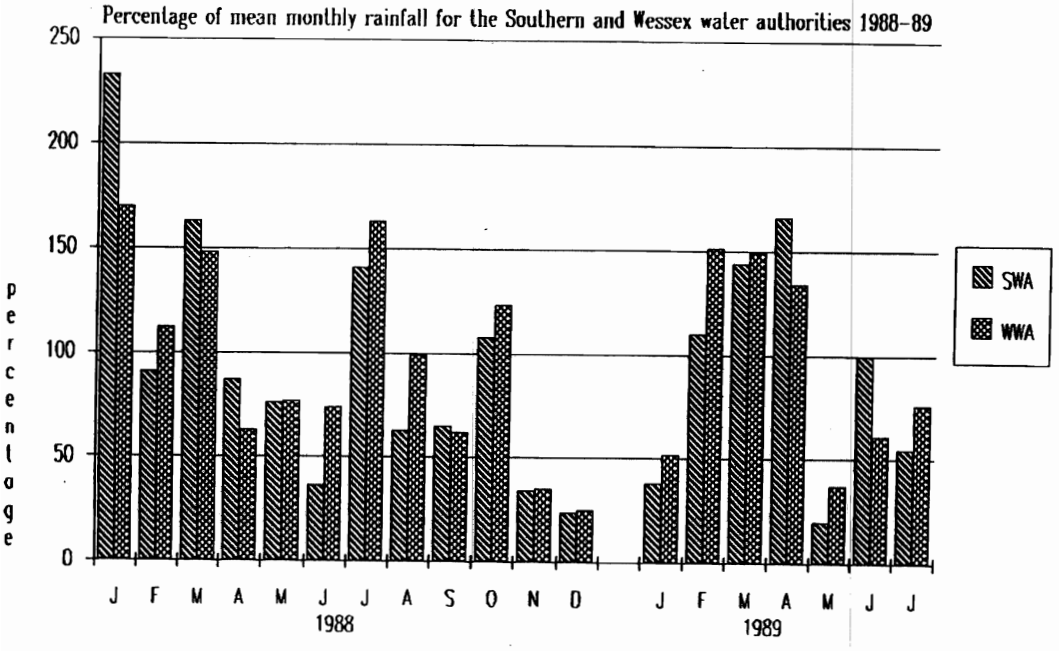
Percentage of mean monthly rainfall for England and Wales 1988-89



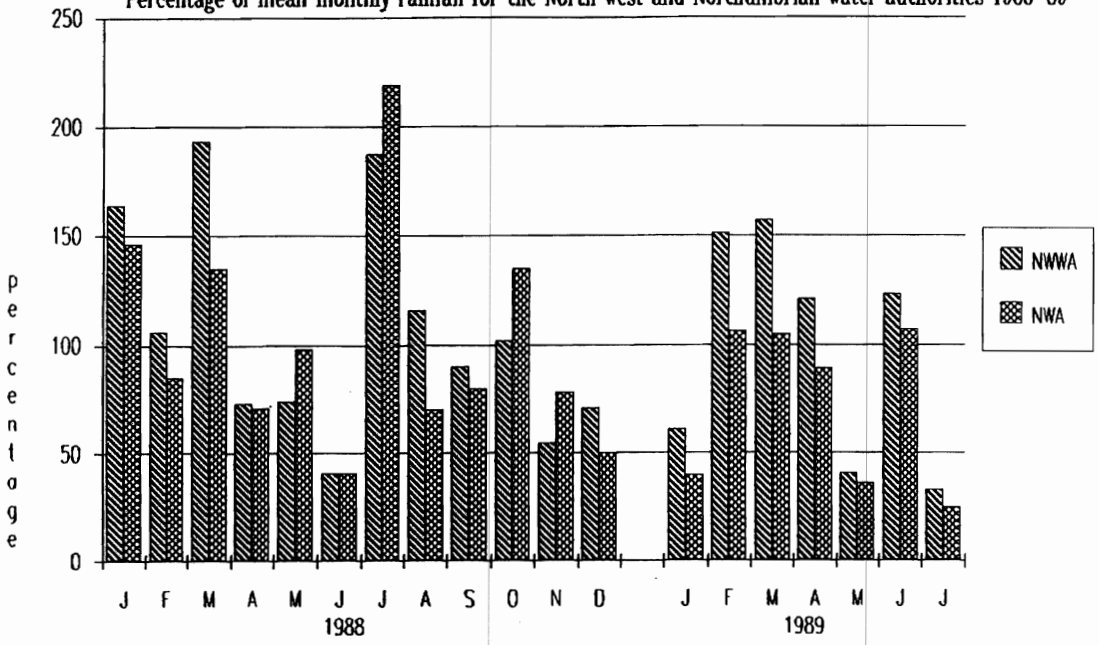
Percentage of mean monthly rainfall for the Anglian and Thames water authorities 1988-89



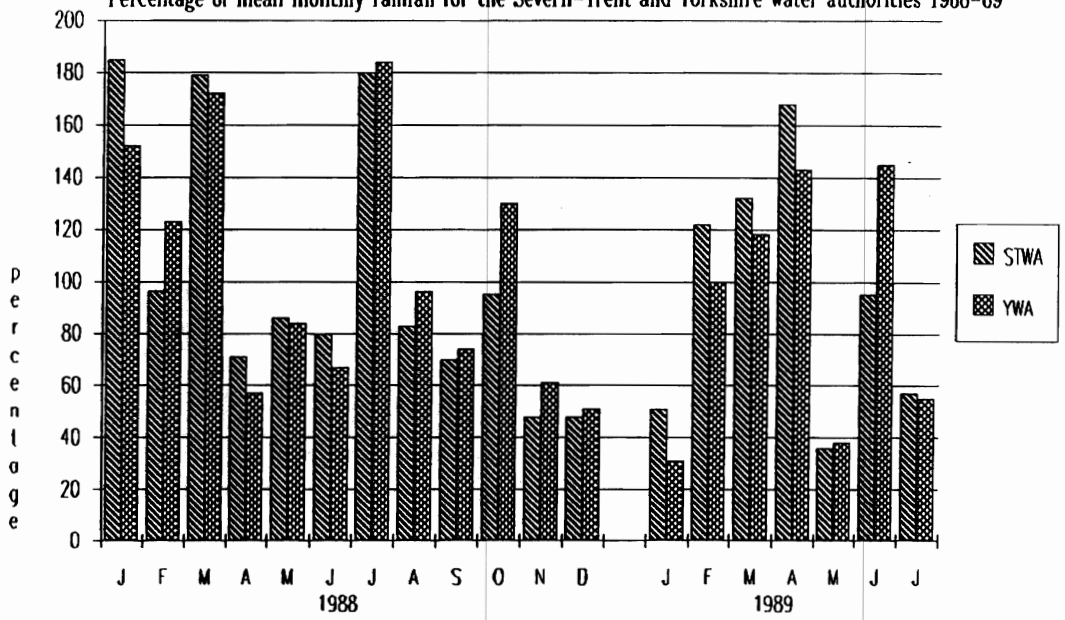
Percentage of mean monthly rainfall for the Southern and Wessex water authorities 1988-89



Percentage of mean monthly rainfall for the North West and Northumbrian water authorities 1988-89



Percentage of mean monthly rainfall for the Severn-Trent and Yorkshire water authorities 1988-89



Percentage of mean monthly rainfall for the South West and Welsh water authorities 1988-89

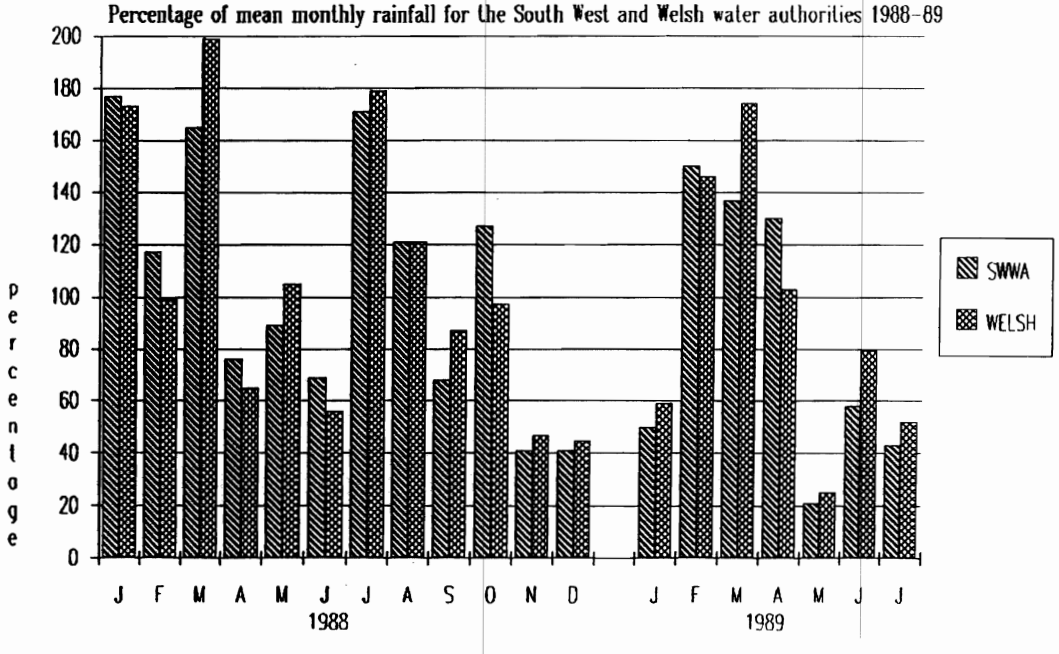


TABLE 1 1988/9 RAINFALL IN MM AND AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Oct 1988	Nov	Dec	Jan 1989	Feb	Mar	Apr	May	Jun	Jul	Oct-Jul	Approx Return* Period	Oct 75-Jul 76
England and Wales	mm	89	48	47	44	78	84	85	22	63	41	601	10-20	441
	%	107	49	52	51	121	142	146	33	103	56	81		60
WATER AUTHORITIES														
North West	mm	120	67	116	68	123	113	92	33	102	34	868	0-5	756
	%	102	55	97	61	151	157	120	40	123	33	90		78
Northumbria	mm	101	73	53	32	70	55	49	25	65	19	542	10-20	467
	%	135	78	71	40	106	105	89	38	107	25	78		67
Severn Trent	mm	62	38	33	35	65	69	87	23	53	37	502	5-10	367
	%	95	48	47	51	122	132	168	35	95	57	80		59
Yorkshire	mm	90	54	47	24	64	63	79	24	84	38	567	0-5	469
	%	130	61	64	31	100	118	140	40	145	55	85		70
Anglia	mm	52	36	22	31	34	48	74	14	62	44	417	5-10	266
	%	100	58	42	59	81	121	186	30	127	77	84		54
Thames	mm	66	28	16	31	68	65	77	14	46	38	441	10-20	260
	%	103	38	24	50	129	141	167	25	88	63	77		45
Southern	mm	84	32	19	29	62	75	81	11	50	32	475	10-20	301
	%	108	34	25	38	109	144	169	20	100	55	73		46
Wessex	mm	101	34	22	44	89	87	74	25	33	47	556	5-10	324
	%	123	35	24	52	151	149	137	36	61	76	79		46
South West	mm	144	55	59	65	135	115	92	18	38	36	757	10-20	553
	%	127	41	44	50	151	137	130	21	58	43	77		56
Welsh	mm	125	67	73	80	140	151	89	23	65	49	862	10-20	693
	%	97	47	50	59	146	174	103	25	79	52	79		64

Note: January to July rainfalls are based upon MORECS figures supplied by the Meterological Office.

*The return periods have been estimated from tables provided by the Meteorological Office.

TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		MAY-JUL 1989	Est. Return Period	JAN-JUL 1989	Est. Return Period	NOV-JUL 1989-89	Est. Return Period	AUG-JUL 1989-89	Est. Return Period
England and Wales	mm	126		417		512		749	
	% LTA	63	15	89	2-5	78	10-15	82	10-12
WATER AUTHORITIES									
North West	mm	169		565		748		1124	
	% LTA	63	15	93	2-5	88	5	92	2-5
Northumbria	mm	109		315		441		676	
	% LTA	54	30	69	30	71	40	77	20
Severn Trent	mm	113		369		440		616	
	% LTA	61	15	90	2-5	79	10	80	10-15
Yorkshire	mm	146		376		477		706	
	% LTA	77	5	86	5	79	10	85	5-10
Anglia	mm	120		307		365		497	
	% LTA	78	5	94	2-5	83	5-10	81	10
Thames	mm	98		331		375		540	
	% LTA	58	15-20	90	2-5	74	15	77	15
Southern	mm	93		340		391		567	
	% LTA	57	15	86	2-5	68	20-30	71	40
Wessex	mm	105		399		455		685	
	% LTA	57	15	91	2-5	73	15	79	10
South West	mm	92		499		613		950	
	% LTA	39	100	82	5-10	70	30	80	10-15
Welsh	mm	137		597		1115		737	
	% LTA	51	30-40	89	2-5	84	7-10	77	10

Return period assessments based on tables provided by the Meteorological Office.

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

River/Station Name		Oct 1988	Nov	Dec	Jan	Feb	Mar	Apr 1989	May	Jun	Jul	Oct 88-Jul 89	Rank/No. of Years	Oct 75-Jul 76
Wharfe at Flint Ml	mm	80	65	81	42	64	95	71	15	13	10	536	8/34	395
	%	125	80	84	43	84	127	131	39	51	37	84		62
Derwent at B'crambe	mm	22	21	29	17	17	22	29	13	9	8	187	2/16	171
	%	92	81	67	33	39	49	85	52	51	59	58		53
Trent at Colwick	mm	23	17	29	21	26	42	57	18	13	12	258	6/31	140
	%	96	55	64	41	59	105	178	69	68	77	78		43
Lud at Louth	mm	14	13	17	15	12	16	17	15	12	10	141	4/21	67
	%	117	87	85	48	33	42	50	54	60	61	55		26
Witham at Claypole	mm	5	5	9	8	8	12	31	14	8	6	106	5/30	37
	%	66	41	44	31	28	46	148	92	80	90	60		21
Ouse at Bedford	mm	11	9	18	13	23	37	46	13	7	7	184	26/56	36
	%	110	45	64	36	85	119	242	101	94	125	88		17
Colne at Lexden	mm	9	7	11	13	14	23	20	6	4	5	113	10/30	43
	%	100	59	65	59	74	128	154	75	82	129	86		33
Thames at Kingston (nat)	mm	14	12	15	13	19	36	26	13	9	7	164	28/106	81
	%	108	57	50	35	59	116	118	76	75	78	72		35
Kennet at Theale	mm	18	14	16	16	19	31	29	22	16	13	194	3/28	96
	%	117	70	59	46	32	82	94	78	76	77	72		36
Coln at Bibury	mm	15	15	18	15	19	48	44	30	18	15	237	2/26	85
	%	88	60	44	30	56	91	102	89	86	67	64		23
Ouse at Gold Bridge	mm	13	10	11	8	12	44	37	16	6	6	163	2/28	141
	%	43	20	20	13	25	98	109	60	40	64	42		37
Test at Broadlands	mm	21	20	20	19	20	31	27	27	17	13	215	3/29	158
	%	90	80	67	50	40	79	79	89	71	62	72		53
Itchen at Highbrdge	mm	28	26	27	26	26	41	40	36	23	22	295	2/31	264
	%	89	75	62	53	46	79	85	83	66	70	71		63
Stour at Throop	mm	25	13	21	19	28	57	39	15	11	8	236	2/16	113
	%	111	40	35	31	51	110	118	63	66	70	62		30
Taw at Umberleigh	mm	109	22	67	54	95	107	36	15	17	4	526	6/31	299
	%	108	24	55	46	116	162	80	48	31	30	81		46
Tone at Bishops H	mm	43	20	26	25	54	80	40	19	11	10	328	5/28	154
	%	164	45	37	31	75	138	107	66	60	65	73		34
Severn at Bewdley	mm	45	22	37	29	48	77	48	12	7	8	333	14/68	180
	%	135	41	58	41	84	168	152	49	41	35	81		44
Yscir at Pont'yscir	mm	91	39	66	92	130	182	72	18	10	11	711	2/16	479
	%	98	28	43	64	123	160	120	41	33	58	78		53
Dee at Manley Hall	mm	105	59	94	75	88	183	98	28	27	30	787	16/52	515
	%	121	84	69	56	84	194	158	61	80	87	92		60
Lune at Caton	mm	129	68	168	94	167	196	82	20	14	12	950	12/25	719
	%	71	42	86	65	192	207	106	37	35	24	98		74

TABLE 4 RIVER FLOW RETURN PERIODS FOR JULY 1989

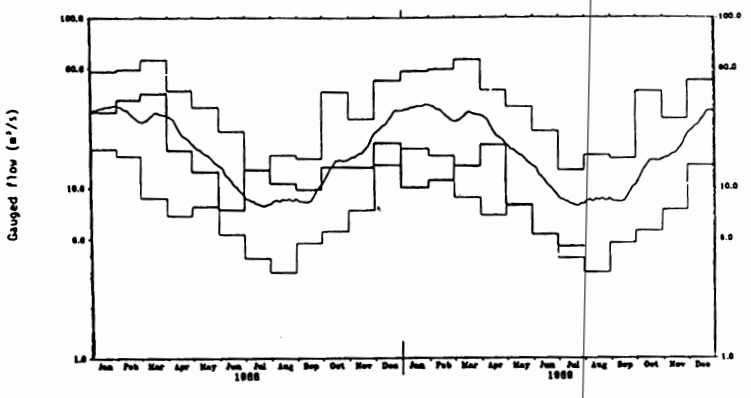
Station	Hyd. Area	Period of Record	July 89 mean flow (m^3s^{-1})	July 89 as a proportion of of July mean	Base Flow Index	Est. return period (yrs)
Warfe at Flint Mill Weir	27	56-88	2.74	0.36	.39	10
Derwent at Buttercrambe	27	74-88	4.50	0.55	.68	20
Trent at Colwick	28	59-88	34.22	0.75	.64	5
Dove at Marston	28	62-88	5.55	0.73	.60	<5
Lud at Louth	29	69-88	0.21	0.60	.90	10
Witham at Claypole Mill	30	60-88	0.71	0.89	.67	<5
Bedford Ouse at Bedford	33	33-88	3.90	1.20	.51	<5
Colne at Lexden	37	60-88	0.45	1.19	.53	<5
Thames at Kingston (nat)	39	1883-89	26.17	0.74	.64	<5
Kennet at Theale	39	62-88	5.08	0.78	.87	5
Coln at Bibury	39	64-88	0.59	0.69	.94	5
Mole at Kinnersley Manor	39	73-88	0.64	0.94	.37	<5
Medway at Teston	40	61-88	1.81	0.60	.41	10
Rother at Udiam	40	63-88	0.27	0.42	.40	25-50
Great Stour at Horton	40	65-88	1.36	0.73	.69	5
Ouse at Gold Bridge	41	60-88	0.41	0.60	.49	5
Itchen at Highbridge	42	59-88	2.93	0.70	.97	25
Avon at Amesbury	43	65-88	1.31	0.65	.91	10
Stour at Throop Mill	43	73-88	3.24	0.71	.66	5
Piddle at Baggs Mill	44	64-88	0.89	0.72	.89	10
Dart at Austins Bridge	46	59-88	1.22	0.31	.52	20
Taw at Umberleigh	50	59-88	1.38	0.29	.42	5-10
Tone at Bishops Hull	52	61-88	0.78	0.65	.58	5
Severn at Bewdley	54	21-88	12.88	0.56	.53	5
Teme at Knightsford Bridge	54	70-88	1.84	0.40	.57	25
Yscir at Pontaryscir	56	72-88	0.26	0.49	.47	5
Cynon at Abercynon	57	58-88	0.63	0.46	.42	10
Lune at Caton	72	59-88	4.46	0.23	.32	20
Eden at Sheepmount	76	68-88	9.70	0.40	.50	20

Based on procedures developed as part of the IH Low Flow Study.

MONTHLY HYDROGRAPHS

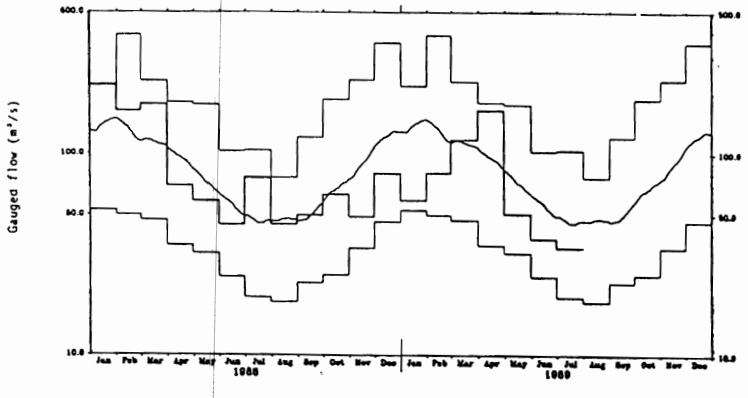
027041 Derwent at Buttercrambe

Monthly mean flows for 1988-1989
+ extremes and 30 day running mean for 1973-1987



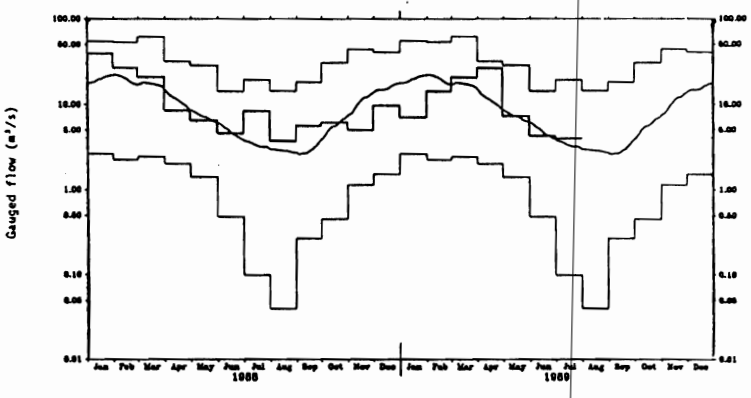
028009 Trent at Colwick

Monthly mean flows for 1988-1989
+ extremes and 30 day running mean for 1958-1987



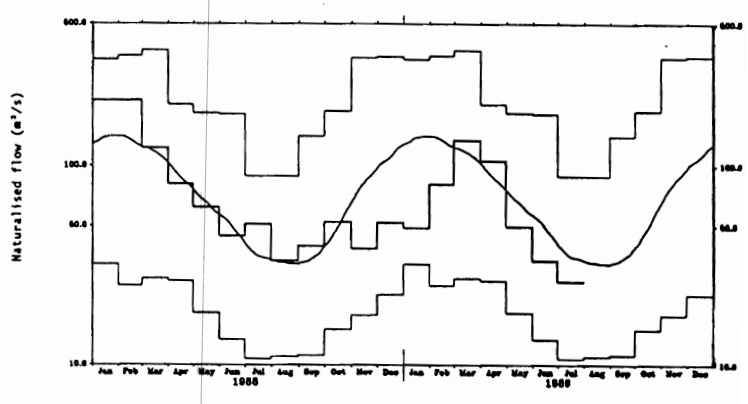
033002 Bedford Ouse at Bedford

Monthly mean flows for 1988-1989
+ extremes and 30 day running mean for 1933-1987



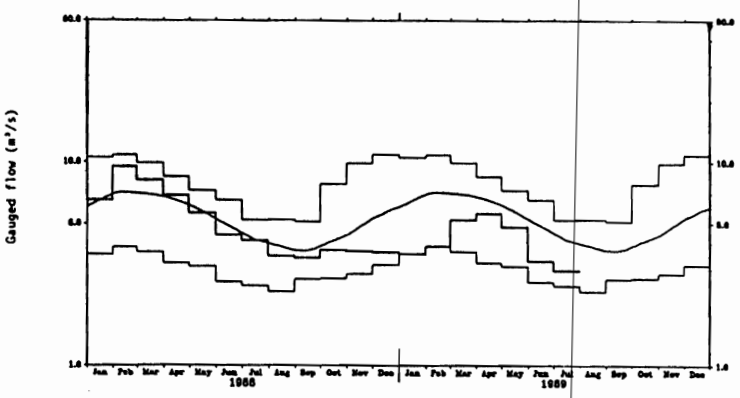
039001 Thames at Kingston

Monthly mean flows for 1988-1989
+ extremes and 30 day running mean for 1883-1987



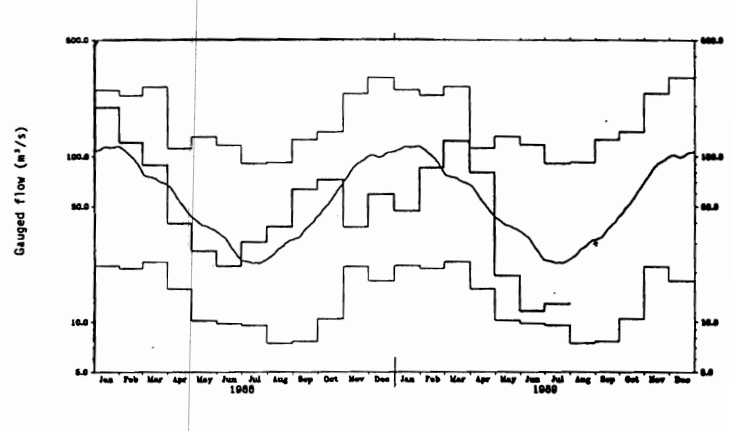
042010 Itchen at Highbridge+Allbrook

Monthly mean flows for 1988-1989
+ extremes and 30 day running mean for 1958-1987



054001 Severn at Bewdley

Monthly mean flows for 1988-1989
+ extremes and 30 day running mean for 1921-1987

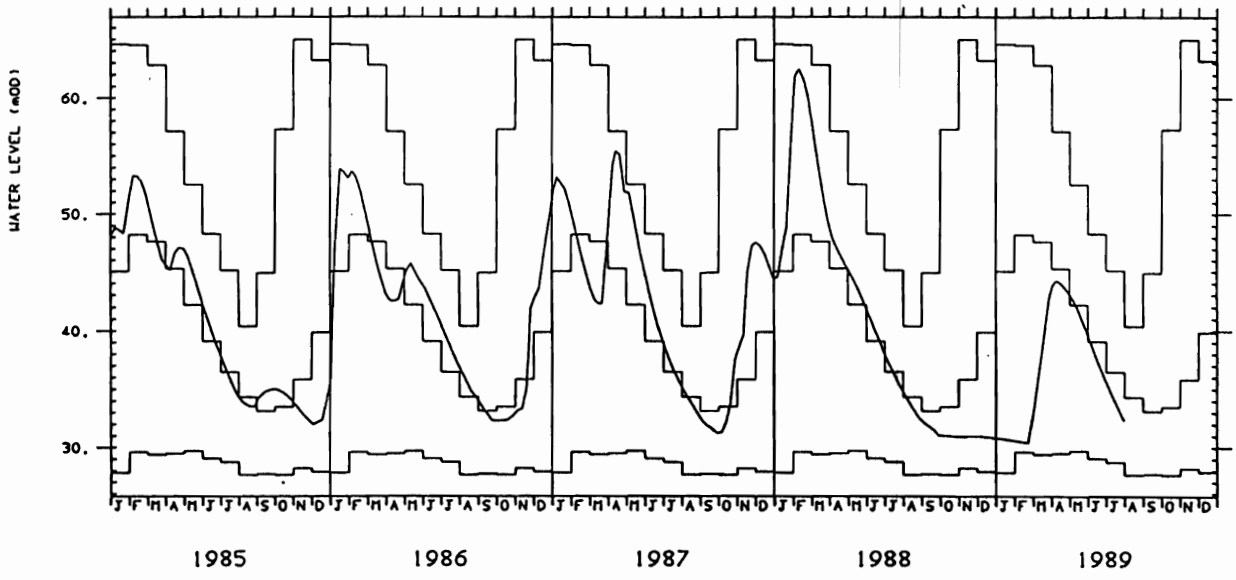


GROUNDWATER OBSERVATION WELL HYDROGRAPHS

Site name: COMPTON HOUSE

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

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



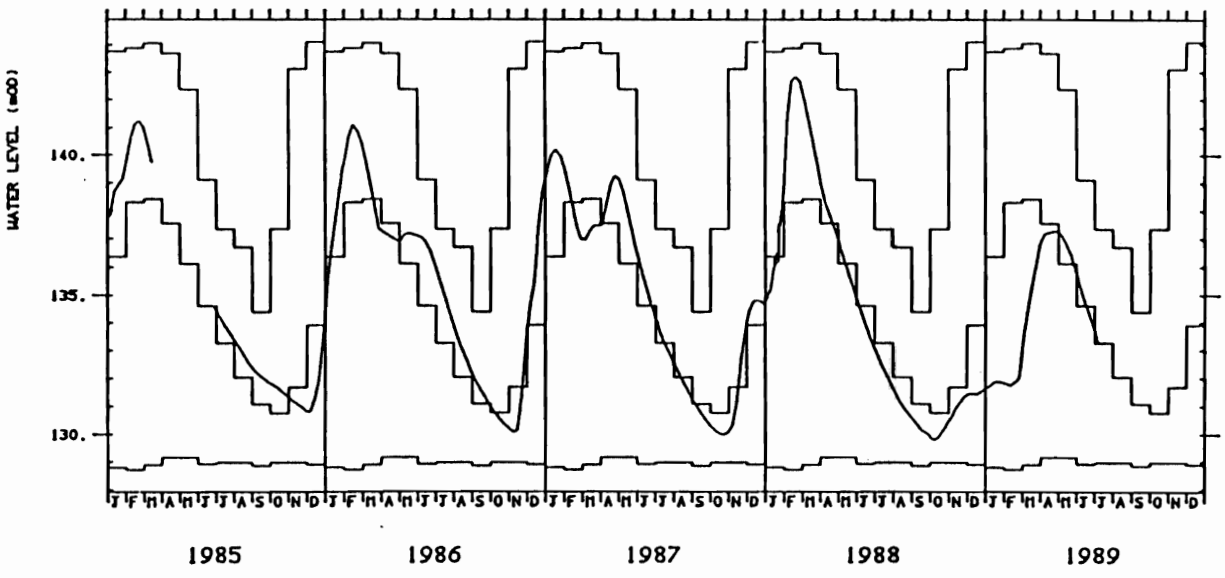
Max, Min and Mean values calculated from years 1894 TO 1988

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

Site name: ROCKLEY

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

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.39



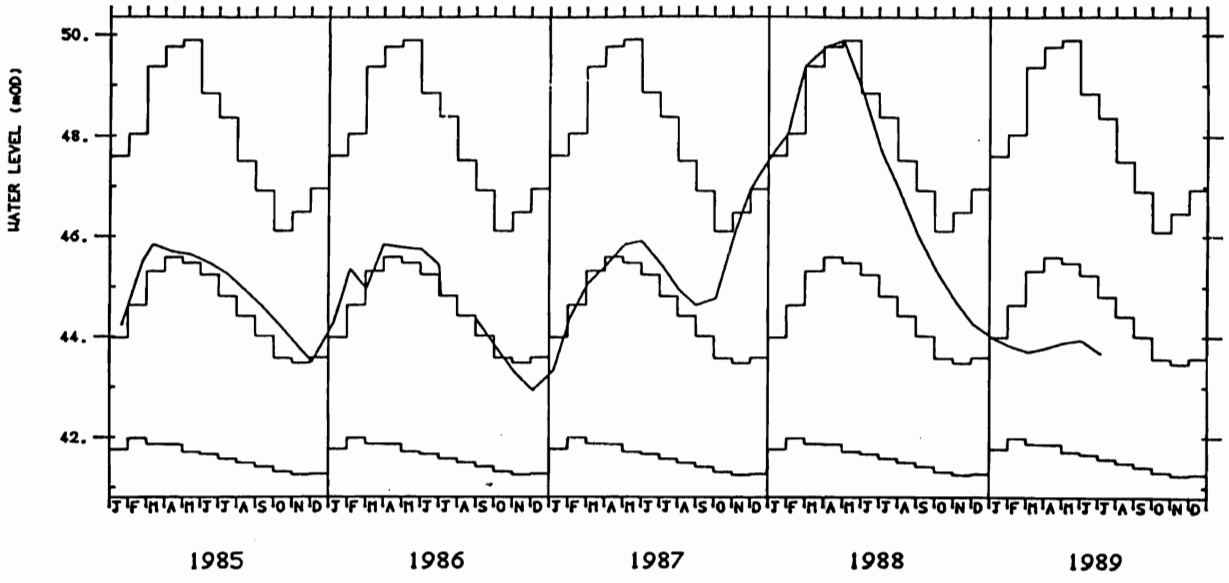
Max, Min and Mean values calculated from years 1933 TO 1988

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



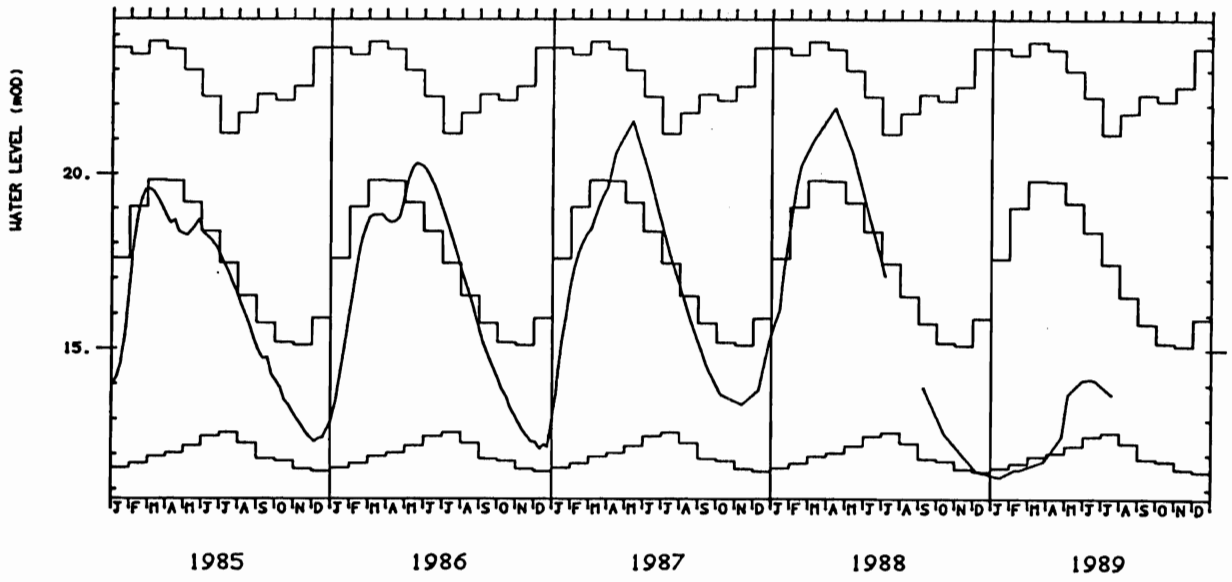
Max, Min and Mean values calculated from years 1950 TO 1988

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

Site name: DALTON HOLME

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

Aquifer: CHALK AND UPPER GREENSAND Measuring level: 33.50



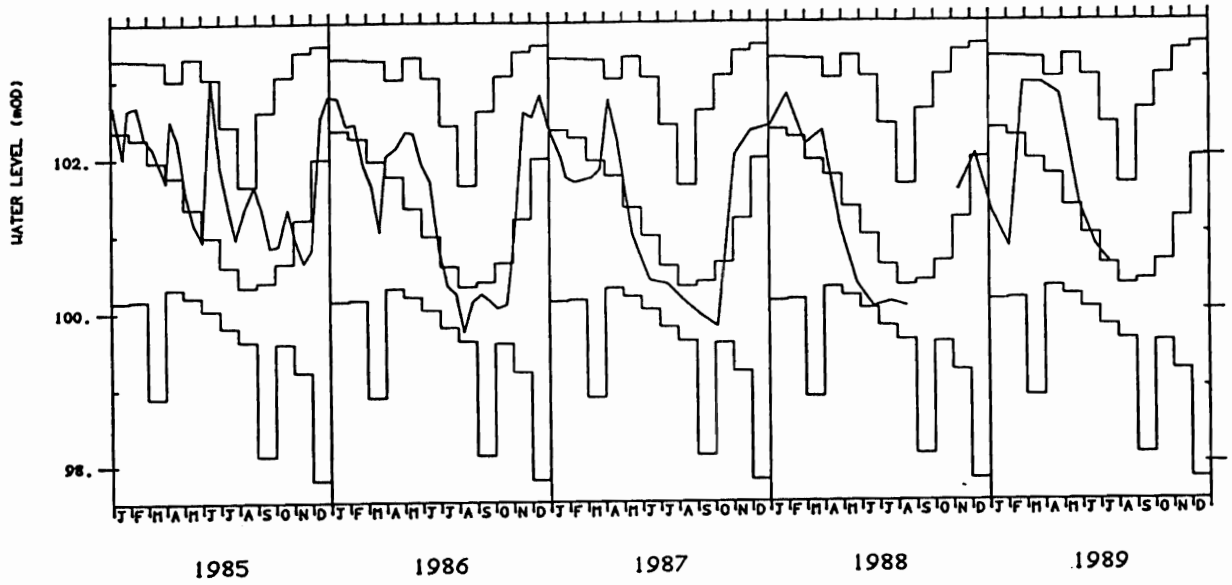
Max, Min and Mean values calculated from years 1889 TO 1988

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

Site name: AMPNEY CRUCIS

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

Aquifer: MIDDLE JURASSIC Measuring level: 109.70



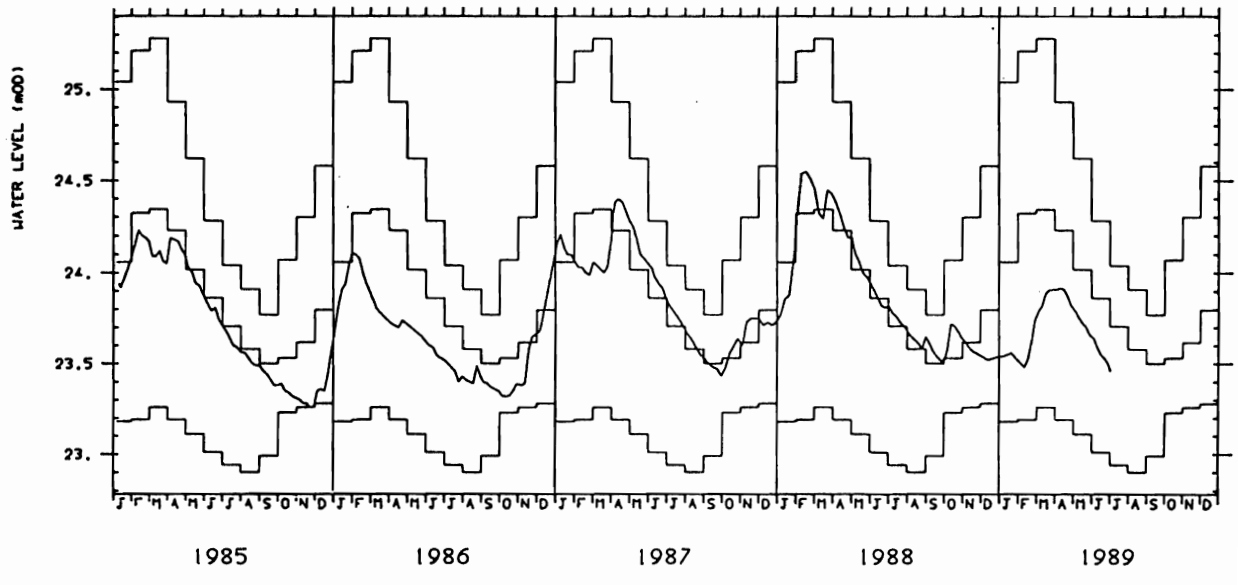
Max, Min and Mean values calculated from years 1958 TO 1988

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

Site name: BUSSELS NO.7A

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

Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.07



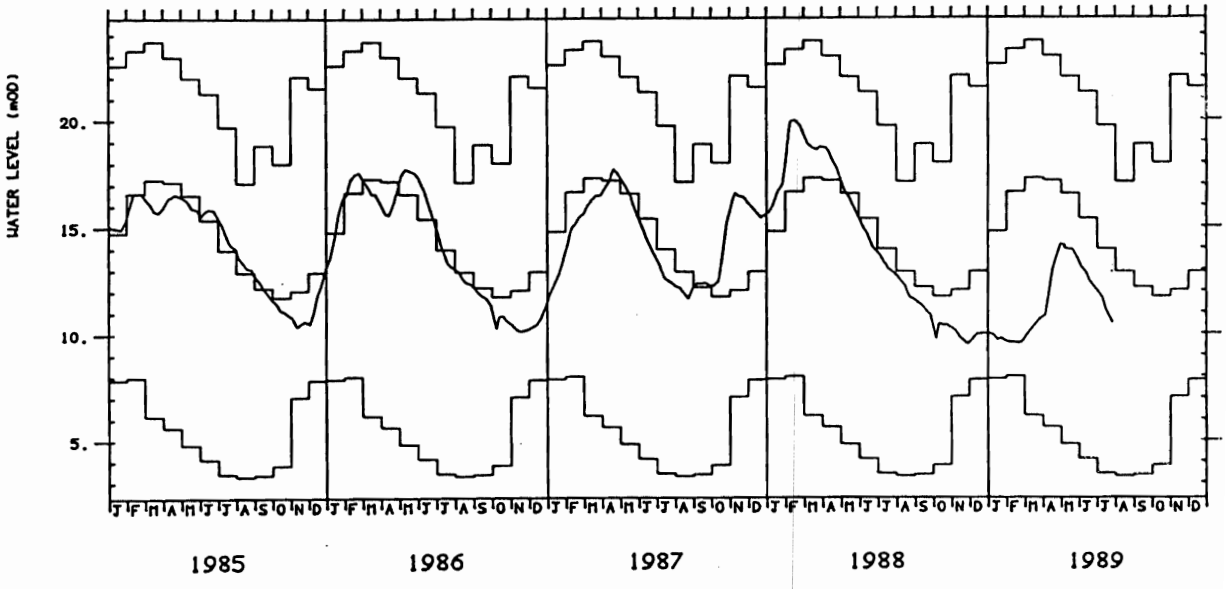
Max, Min and Mean values calculated from years 1972 TO 1988

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

Site name: NEW RED LION

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

Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.82



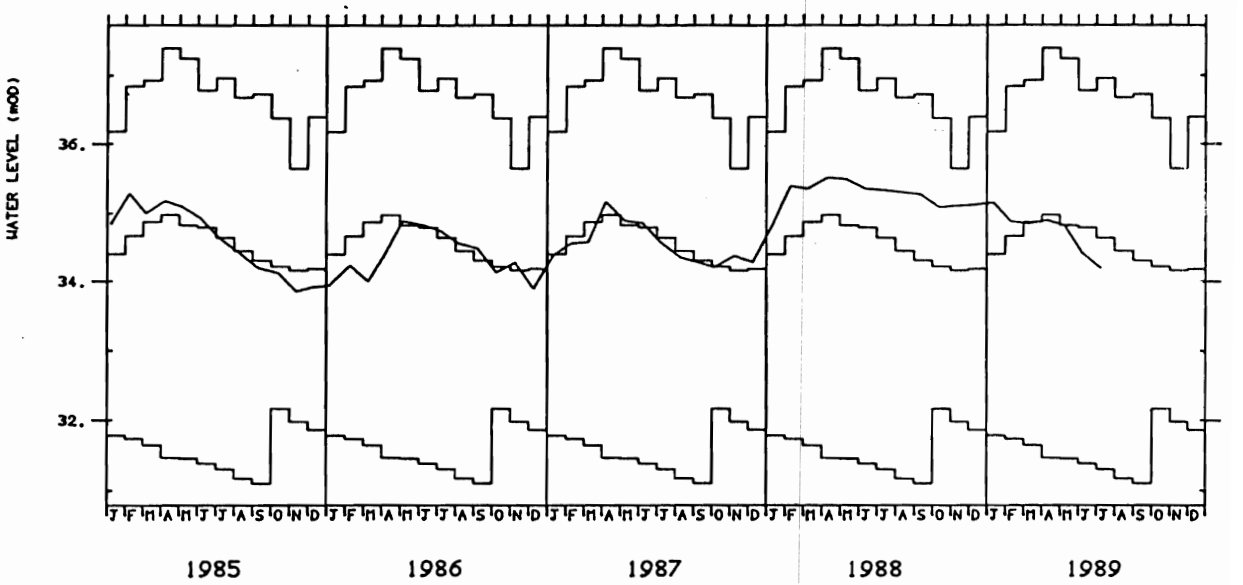
Max, Min and Mean values calculated from years 1964 TO 1988

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

Site name: 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