HYDROLOGICAL SUMMARY - JANUARY 1990

Data for this review 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.

The recent areal rainfall figures are derived from a restricted network of raingauges and a significant proportion of the river flow data is of a provisional nature. Flood warning and alleviation duties took priority late in January; consequently, data for some rivers are incomplete and the monthly runoff figures may require revision in the event of station recalibration following the recent high flows.

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

SUMMARY

The extremely variable weather which has been a feature of the winter thus far continued into early 1990. Generally, January was warm and wet. A sequence of vigorous frontal systems crossed the British Isles, switching most hydrological interest away from the declining drought to the widespread flooding experienced towards the end of the month, which continued into February.

The transformation in the water resources outlook, which began in December, gathered momentum through the first six weeks of 1990 but a continuing drought may still be recognised in a few isolated eastern coastal areas.

After a brief respite in early January the extremely unsettled weather which characterised the latter half of December became re-established. Rainfall was persistent and widespread from mid-month and, with zero soil moisture deficits obtaining generally, flooding was reported from many areas. Fluvial spate conditions continued into February when, by the 6th, exceptionally high flow rates were experienced in many rivers throughout Great Britain. Rainfall patterns showed a strong steepening of the normal west-to-east gradient with a few localities on the eastern seaboard remained relatively dry. However, apart from a few isolated localities, the drought in England and Wales may be considered to have ended by mid-February, in meteorological terms. On a regional basis, rainfall for the winter (from 1st December) has been above average, substantially so in southern Britain, and accumulated precipitation totals for the last 12 months are close to the long term average, with the exception of eastern Scotland. Hydrologically, the picture is far less clear-cut. Runoff totals for January are generally within the normal range and accumulated totals for the winter so far climbed rapidly through January in response to the hydrologically effective rainfall.

The groundwater situation defies any simple generalisation due to the large geological and temporal variation in recharge rates over the first six weeks of the year. Healthy upturns in groundwater levels have been recorded in western and some southern aquifer units. But the outlook remains fragile in a few eastern districts where only a sluggish response had occurred by the end of January. Generally, however, runoff and recharge data testify to a very marked improvement in water resources over the last 8-10 weeks. The water resources outlook is also very much healthier than at the corresponding time in 1989.

REVIEW

Rainfall

Weather patterns during January were influenced by a persistent, moist, south-westerly airstream which became more dominant from mid-month. A series of vigorous depressions crossed the British Isles culminating in an especially violent storm on the 25th which caused considerable damage and resulted in significant loss of life. A number of very active frontal systems followed in the wake of this depression. The associated rainfall over the ensuing fortnight, torrential at times, yielded totals which were notable throughout most of Britain; over three times the average in the Scottish Highlands and a large proportion of southern England and South Wales.

Rainfall totals for January were below average over a substantial part of East Anglia and in restricted coastal districts from north Kent to north-east Scotland. Rain shadow effects were again strongly evident in the Scottish Highlands and the remarkable contrast between precipitation amounts along a transect roughly from Mull to Aberdeen, which has been a persistent feature, continued. Winter rainfall in the Fort William region has been about twice the average, whereas Aberdeen registered its fifteenth successive month with below average rainfall. Some eastern districts have recorded only 50-60% of mean rainfall over this period; similar rainfall deficits characterise coastal localities adjacent to the Tweed estuary. Droughts of this magnitude may be expected, on average, less often than once every several hundred years.

January is normally one of the wettest months of the year. In England and Wales, significant reductions in the accumulated rainfall deficits had been registered by month-end. These diminished further in early February when, in much of southern Britain, torrential rain caused the monthly average to be exceeded before the end of the first week. A large tract of central southern England recorded more than three times the average rainfall for the fortnight beginning on the 24th January.

Notwithstanding the very dry spell in November to mid-December, regional rainfall amounts throughout Britain from the beginning of October are close to or above the average, particularly so in southern Britain. If account is taken of the February rainfall the picture is even more encouraging. Rainfall over the Thames catchment since October, for instance, now exceeds the average for the full winter half-year; over the December to February period the rainfall is already the highest for more than fifty years.

In eastern Scotland the situation is different. Even with the high rainfalls which have fallen over the headwaters of the North East RPB, the accumulated deficits from periods as far back as October 1988 show significant shortfalls from average conditions; January was the first month to exceed average rainfall since March 1989 (Table 1). The rarity of some of the accumulating periods is shown in Table 2. Similar, though more moderate, conditions have typified the Tweed and the Tay RPBs. The more volatile conditions in the west and central Scotland are clear from the 1989 and January 1990 rainfall from the Highland and Clyde RPBs; individual months have shown variations from below 50 to above 250% of the long term average falls.

Soil Moisture Deficit (SMD)

With the exception of a few coastal districts bordering the North Sea, SMDs hovered around zero throughout January. In an average year modest deficits may persist well into the winter in low-lying parts of south-east England. By the end of January 1990 the area showing zero SMDs was significantly greater than average and in marked contrast to 1989.

Notable deficits are now restricted to the Northumbrian coast and the lowest portion of the Tweed Valley.

Runoff

Following a high flow episode over the Christmas period most rivers were in recession in early January. Recessions in lowland England were relatively steep; baseflows were still very depressed. Flow rates generally picked up through the month and spate conditions obtained over wide areas from the beginning of the last week. Moderate to severe flooding ensued over the following three weeks. Overbank flows typified large areas but the higher magnitude floods were recorded in the West Country and South Wales, the lower Severn, the Thames Valley and many rivers draining from the western highlands of Scotland. Unprecedented discharge rates were registered for the headwaters of the Spey and on the Tay, the Ballathie gauging station recorded a daily mean discharge on the 5th February of 1750 m^3s^{-1} despite considerable attenuation of the flood peak resulting from an breach in the floodbanks upstream. This flow rate exceeds the highest daily mean on the Surface Water Archive for the whole of the United Kingdom.

January runoff totals were within the normal range other than other than the depressed totals in the Chalk of Yorkshire and Lincolnshire and parts of East Anglia. Accumulated runoff totals through the winter and over durations of 9 and 15 months remain modest in some eastern and southern catchments (Table 3). The Dee at Park in Scotland and the Yorkshire Derwent at Buttercrambe recorded the second lowest and lowest December to January accumulations on record, respectively. In contrast, the more responsive catchments towards the west had runoff totals for December and January which exceeded the combined totals for the preceding 8 to 10 months; the totals for both the Teme and the Yscir were new records. Some southern catchments with significant baseflow support have shown similar patterns, as in the Thames to Kingston. The provisional peak flow of 276m^3s^{-1} at Knightsford Bridge on the 28th January on the Teme was comparable with the highest on record, in December 1979.

Groundwater

Groundwater levels at the beginning of winter were inordinately low, particularly in some eastern and southern aquifers. A belated seasonal upturn generally began over the latter part of December. However, apart from some western areas, groundwater levels were still below average at the end of the year. During January, further heavy rainfall led to continued infiltration and consequent rises in groundwater level in the south-west and south of England, but the effects appear to have been much less marked in the extreme south east, the north Midlands and the north-east. Sustained above-average rainfall will be required in these latter districts through February and March for the groundwater levels to approach mean values before the onset of the summer recessions.

The upturns in groundwater levels observed in late December were generally continued through January, and are illustrated in the well hydrograph in Figure 4. In the south-west of England, the levels in the Bussels No. 7 site reached the mean monthly level by the end of the month. The rise in the Chalk of southern England (the Compton and Rockley sites) also continued although levels were still beneath the late January means. The very transitional nature of January levels is however well illustrated by the subsequent behaviour of the Rockley trace. By February 13th, a very sharp rise had taken the water table to its highest level - with the exception of the late winter in 1988/89 - for a decade. Similar conditions have been exhibited on the Isle of Wight. In the North-East, East and eastern Kent, the picture is very different. At the Dalton Holme site in the Yorkshire Chalk, the groundwater level, although rising, is still beneath the seasonal recorded minimum. For the Washpit Farm site in the Anglian Chalk, it has not been possible to obtain recent readings from the measuring authority, but the level at the end of December was still falling and it seems probable that little upturn has yet occurred. Some recently acquired values from a Chalk boreholes in the Canterbury district in Kent show that groundwater levels are rising, but remain at or below the minimum recorded values. As usual, the Oolitic Limestone aquifers of the Jurassic (the New Red Lion and Ampney Crucis sites) have shown a brisk response to rainfall and levels are close to the seasonal mean.

The state of groundwater resources is indicated by the groundwater levels. The degree of recharge in any given season is quantified by the rise from the trough at the end of the summer recession to the peak before the beginning of the recession in the following year. Since the specific yield (or storativity)* within and between aquifers is very variable, the range through which groundwater levels may fluctuate also varies widely from one observation well to another. This makes a direct comparison meaningless. To circumvent this problem, the mean trough levels and the mean peak levels are determined for as long a period of record as possible (and not less than 10 years) for each observation site. The difference between these two values is defined as the mean annual range for that site and is, incidentally, assumed to be the rise in groundwater level which would be caused by the average annual infiltration. A change in groundwater level can be expressed as a percentage of the mean annual range, and the percentage values thus obtained can be compared between different observation sites.

On the accompanying table, details are given for 7 indicator well sites, showing the mean annual range, the levels for late January 1989, 1990 and 1976, (levels in metres above Ordnance Datum), and the difference between the latter levels as a percentage of the mean annual range.

Site	Mean Annual Range, m.	1989	1990	1976	Difference %
Compton House	21.76	30.62	34.71	30.38	+20
Rockley	10.91	128.97	133.30	131.84	+40
Dalton Holme	7.10	11.35	11.07	12.70	-23
New Red Lion	9.21	9.63	12.32	8.52	+41
Ampney Crucis	3.07	100.60	102.44	100.37	+67
Bussels No. 7	1.17	23.52	24.11	23.23	+75
Peggy Elleron Farm	1.40	35.16	34.24	31.78	+175

Five of the sites show difference values of 20 to 75 percent, substantially above 1976 levels. At Peggy Ellerton Farm, the January 1976 levels were remarkably low even in the context of that year, but even so the difference of 175 percent is rather large and suggests that the mean annual range may need a re-evaluation. At the Dalton Holme site, the difference is negative, being 20 per cent below the 1976 value. The observation well near Waltham in Kent, one of those to which reference was made in a previous paragraph, provided data which, being analysed in the same manner, suggests that the percentage difference from 1976 is negligible. Unfortunately, it has not been possible to obtain data for January from the Washpit Farm observation well in East Anglia; at the end of December 1989, the groundwater level was near to the minimum recorded seasonal value, and it seems probable that the difference by late January would be of the order of 10 to 20 percent below the 1976 value.

From these calculations, if near average conditions are to be attained by the end of March 1990, when the summer recession is likely to start, then substantial steady, evenly distributed, rainfall will be required through February and March (very heavy rain may lead to increased runoff as it may exceed the infiltration capacity of the soil). Abnormally heavy rainfall would be necessary to attain the same object in East Yorkshire, in parts of East Anglia and in Kent. The early February rainfall has been encouraging in this regard.

Institute of Hydrology / British Geological Survey 16 February 1990

* Specific Yield in an unconfined aquifer is the ratio of the volume of water drained by gravity from a mass of the aquifer to the volume of that mass.

TABLE 1 1989/90 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Jan	Feb	Mar 1989	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 1990	Nov 89 -Jan 90	Shortfall Nov88- Jan 90
England and	mm	44	78	84	85	22	63	41	60	40	95	62	135	116	313	157
Wales	%	51	120	142	147	33	103	56	66	48	114	64	150	135	115	
NRA REGIONS																
North West	mm	68	123	113	92	33	102	34	118	28	136	75	103	178	356	181
	%	61	152	157	119	40	123	33	94	22	115	62	86	159	101	
Northumbrian	mm	32	70	55	49	25	65	19	87	21	85	36	61	110	207	286
	%	40	106	106	89	39	107	25	86	26	113	38	81	138	83	
Severn Trent	mm	35	65	69	87	23	53	37	40	37	83	51	126	113	290	101
	%	51	123	133	167	36	95	57	49	54	128	65	181	164	133	
Yorkshire	mm	24	64	63	79	24	84	38	47	19	83	46	93	106	245	191
	%	31	100	119	141	39	145	54	52	27	120	52	126	138	102	
Anglia	mm	31	34	48	74	14	62	44	37	29	43	37	95	52	184	120
	%	60	81	120	185	30	127	77	57	56	83	60	180	100	110	
Thames	mm	31	60	65	77	14	46	38	40	32	66	37	134	86	257	135
	%	50	128	141	167	25	88	63	57	51	103	51	203	139	128	
Southern	mm	29	62	75	81	11	50	32	28	29	80	44	137	110	291	226
	%	38	109	144	169	20	100	54	39	41	102	47	169	145	116	
Wessex	mm	44	89	87	74	25	33	47	45	52	103	60	174	124	358	128
	%	52	151	150	137	37	61	76	55	66	126	62	193	147	132	
South West	mm	65	135	115	92	18	38	36	63	99	141	97	192	181	470	206
	%	50	150	137	130	21	58	43	62	96	125	72	142	140	118	
Welsh	mm	80	140	151	89	23	65	49	78	57	164	100	189	211	500	219
	%	59	146	174	103	25	79	52	66	46	127	70	130	155	118	
Scotland	mm	172	239	188	71	58	84	60	181	89	173	62	100	218	380	-77
	%	126	230	204	79	64	91	54	140	65	116	44	64	159	87	
RIVER PURIFICATION BOARDS																
Highland	mm	319	355	233	60	68	90	66	222	118	252	83	107	290	480	-357
	%	195	267	204	53	66	82	52	150	75	135	49	55	177	91	
North-East	mm	52	113	83	54	59	57	25	84	57	87	30	61	100	191	341
	%	57	153	134	89	77	81	27	78	66	90	29	60	110	65	
Tay	mm	156	197	173	45	42	58	31	140	84	135	53	87	230	370	25
	%	132	214	211	60	44	70	30	119	73	111	45	65	195	100	
Forth	mm	133	158	151	44	36	64	27	142	69	112	38	78	210	326	13
	%	134	205	219	65	43	85	28	122	64	106	35	72	212	103	
Clyde	mm	232	262	229	82	46	90	64	249	120	240	74	107	320	501	-242
	%	144	232	218	80	47	87	49	175	69	131	44	58	199	97	
Tweed	mm	71	105	105	48	43	51	23	114	47	67	30	72	158	260	239
	%	76	152	181	79	57	75	27	100	51	76	29	80	170	91	
Solway	mm	139	157	195	87	35	71	43	177	78	146	58	117	270	445	66
	%	99	169	214	99	38	79	39	136	52	101	40	77	193	102	

Note: Rainfalls have been provided by the Meteorologiical Office. Recent monthly values for England and Wales have been taken from the MORECS Bulletins; in Scotland data may be provisional and the January 1990 data have been estimated from the national map provided with the MORECS Bulletins

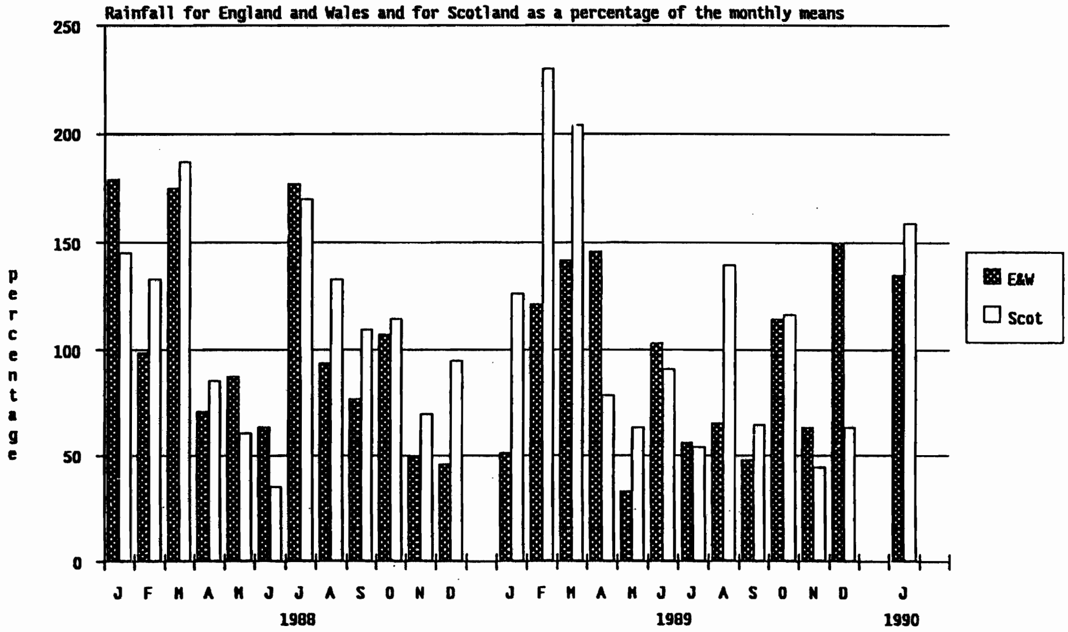
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

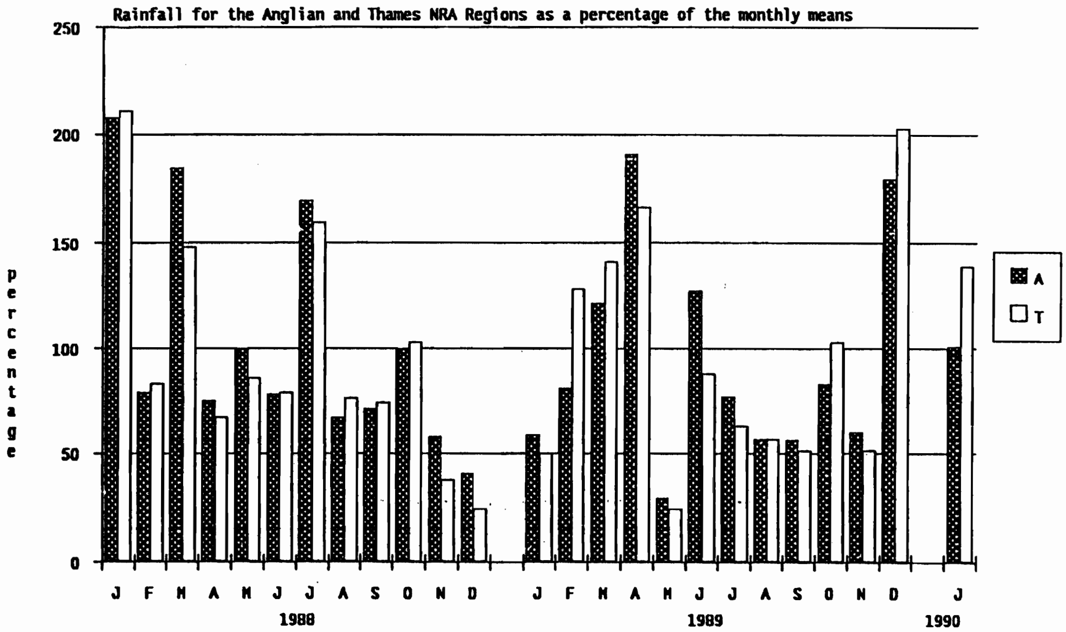
		OCT 89 - JAN 90	Est Return Period	MAY 89 - JAN 90	Est Return Period	OCT 88 - JAN 90	Est Return Period
England and Wales	mm	408		633		1108	
	% LTA	114	<5	87	<5	87	5-10
NRA REGIONS							
North West	mm	493		807		1509	
	% LTA	105	<5	82	5-10	89	5-10
Northumbrian	mm	292		509		943	
	% LTA	90	<5	72	20-50	78	20-50
Severn Trent	mm	374		564		953	
	% LTA	132	5-10	91	<5	90	<5
Yorkshire	mm	329		541		963	
	% LTA	106	<5	82	5-10	84	10-20
Anglia	mm	228		413		709	
	% LTA	104	<5	85	5-10	86	5-10
Thames	mm	324		493		836	
	% LTA	122	5	87	<5	86	5-10
Southern	mm	371		521		903	
	% LTA	113	<5	82	5-10	80	10-20
Wessex	mm	461		663		1113	
	% LTA	130	5-10	95	<5	91	<5
South West	mm	611		865		1530	
	% LTA	119	<5	91	<5	90	<5
Welsh	mm	664		937		1664	
	% LTA	120	5-10	88	<5	88	5-10
Scotland	mm	553		1025		2113	
	% LTA	95	<5	89	5-10	105	<5
RIVER PURIFICATION BOARDS							
Highland	mm	732		1296		2693	
	% LTA	102	<5	95	<5	111	5-10
North-East	mm	271		559		1159	
	% LTA	69	20-50	68	100-200	82	20-50
Tay	mm	505		860		1806	
	% LTA	103	<5	85	5-10	103	<5
Forth	mm	438		776		1630	
	% LTA	104	<5	86	5-10	106	<5
Clyde	mm	741		1310		2612	
	% LTA	106	<5	97	<5	111	5-10
Tweed	mm	329		623		1147	
	% LTA	88	<5	76	10-20	83	10-20
Solway	mm	591		995		1964	
	% LTA	122	5-10	86	5-10	98	<5

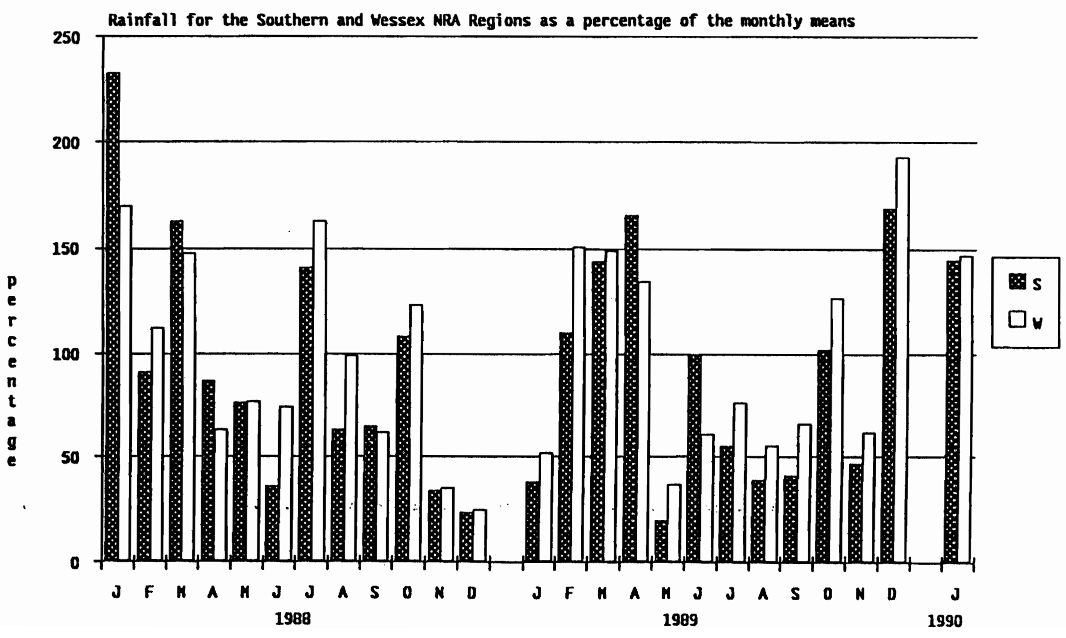
Return period assessments are based on tables provided by the Meteorological Office.* These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.
The January 1990 RPB totals are estimates taken from the isopleth map within the January summary published in the Meteorological Office's MORECS Bulletin.

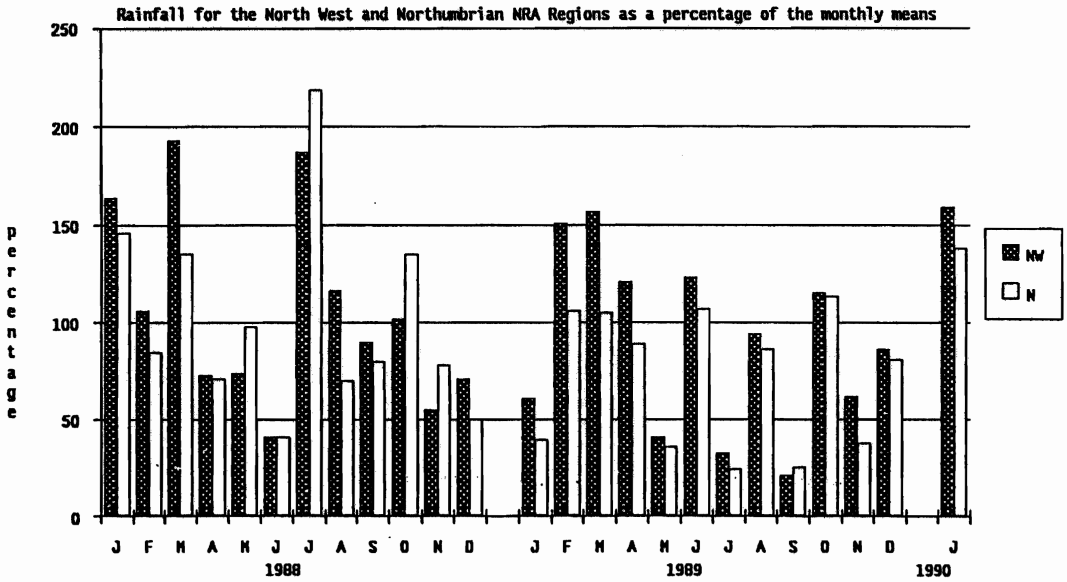
* Tabony, R.C., 1977, The Variability of Long-duration Rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office, (HMSO)

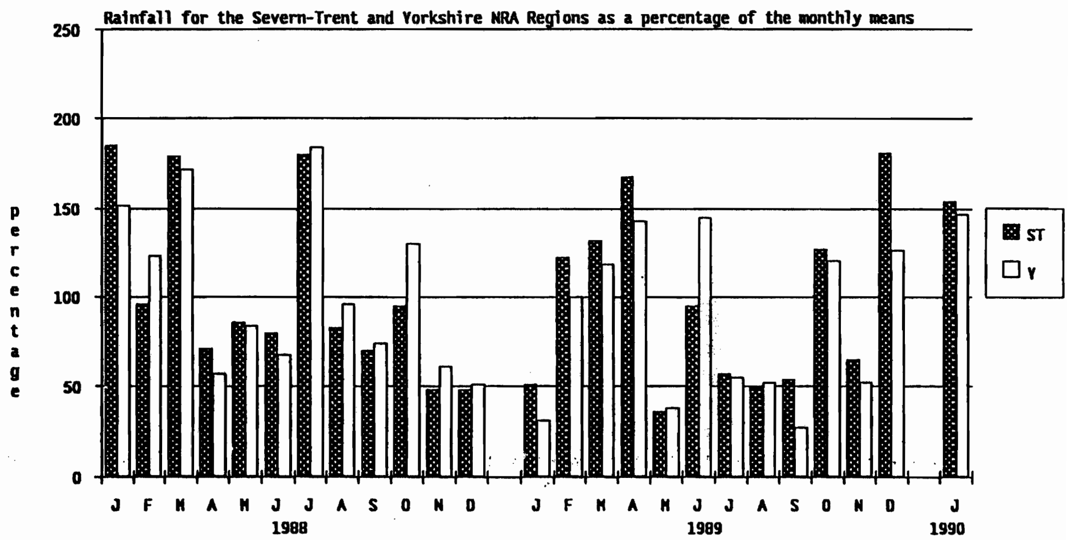
FIGURE 1 HISTOGRAMS OF RAINFALL AS A PERCENTAGE OF THE MONTHLY MEAN








Rainfall for the North West and Northumbrian NRA Regions as a percentage of the monthly means
250
200
150
100
50
0
percentage
NW
N
J F M A M J J A S O N D J F M A M J J A S O N D J
1988
1989
1990


Rainfall for the Severn-Trent and Yorkshire NRA Regions as a percentage of the monthly means
250
200
150
100
50
0
percentage
ST
Y
J F M A M J J A S O N D J F M A M J J A S O N D J
1988
1989
1990

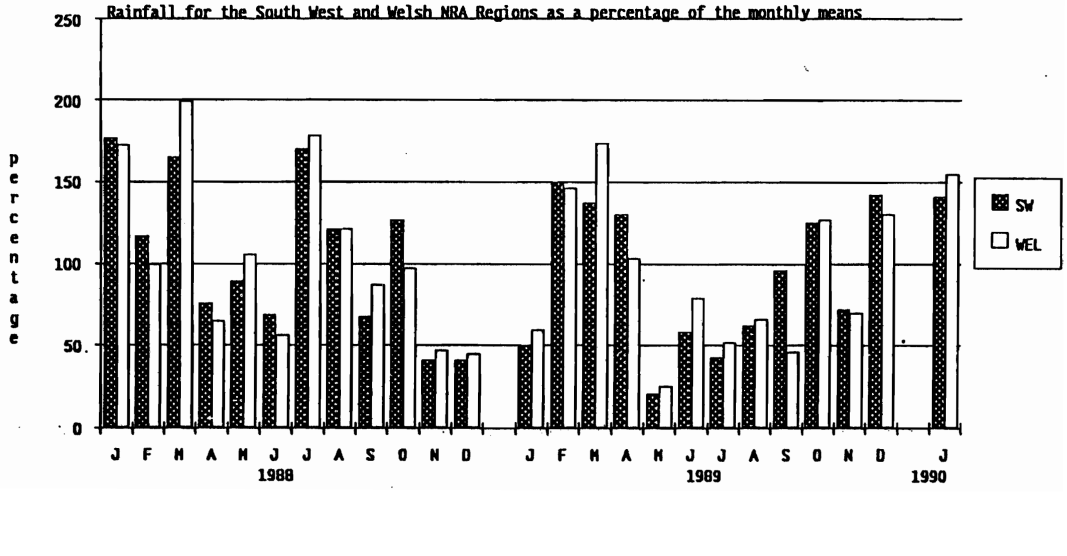
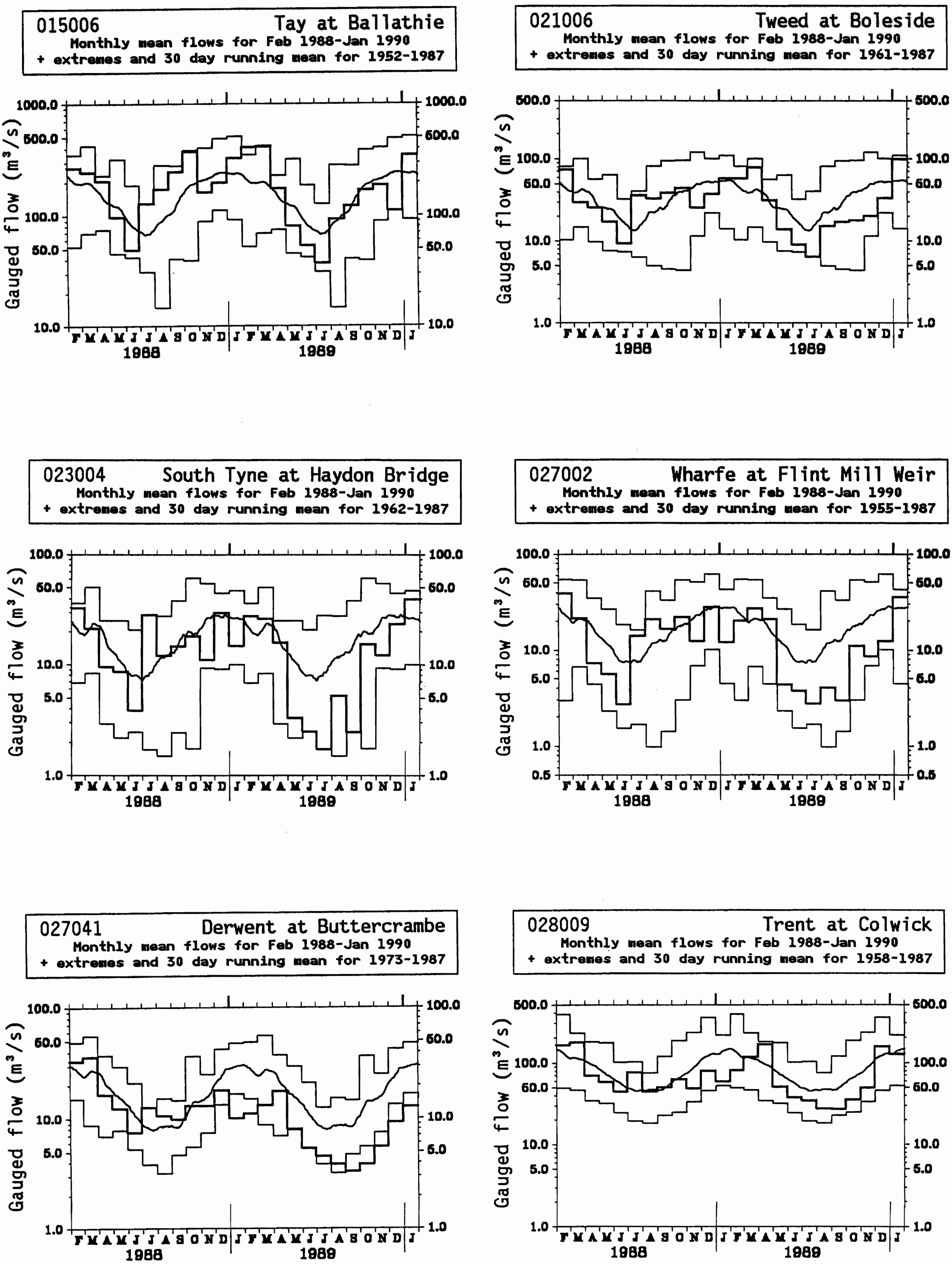
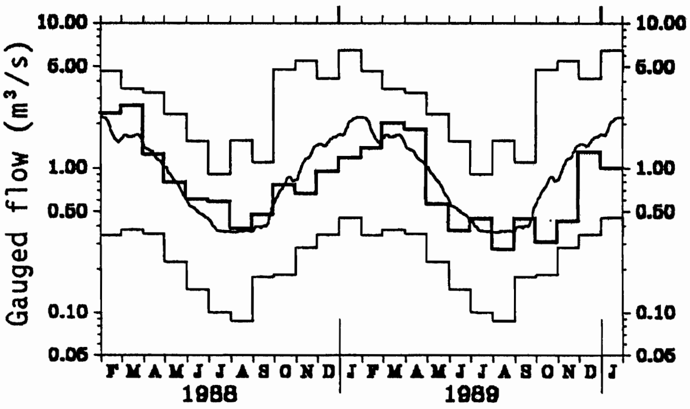

Rainfall for the South West and Welsh NRA Regions as a percentage of the monthly means
250
200
150
100
50
0
percentage
SW
WEL
J F M A M J J A S O N D J F M A M J J A S O N D J
1988
1989
1990

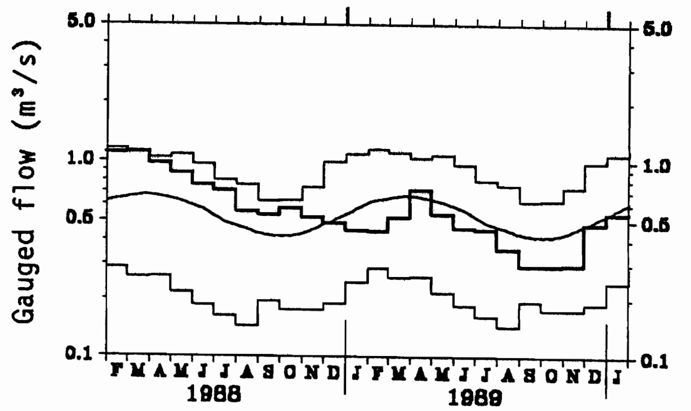
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS



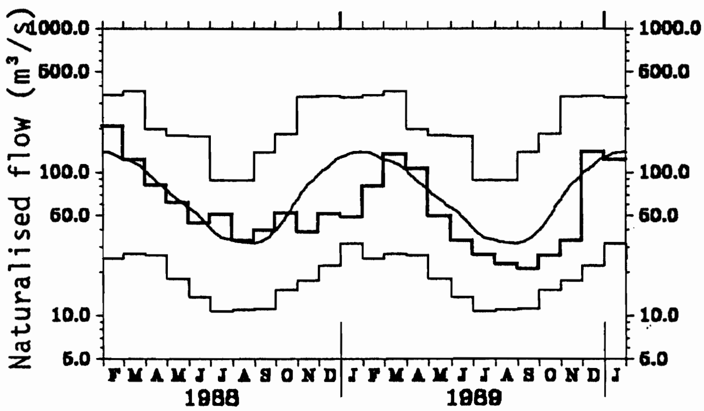
037005 Colne at Lexden
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1959-1987



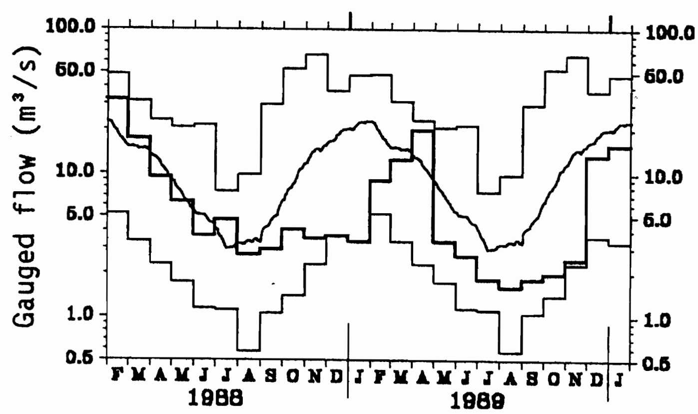
038003 Mimram at Panshanger Park
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1952-1987



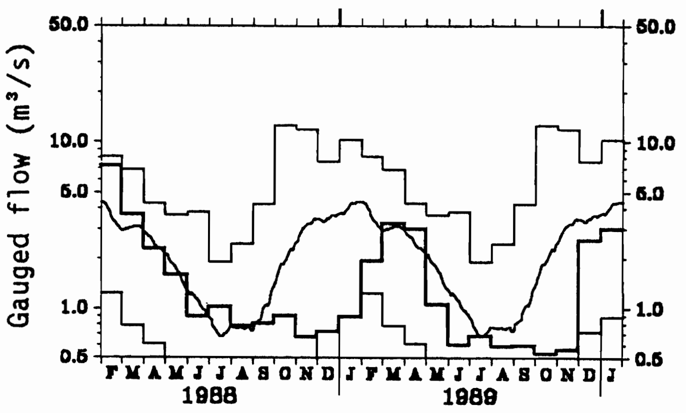
039001 Thames at Kingston
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1883-1987



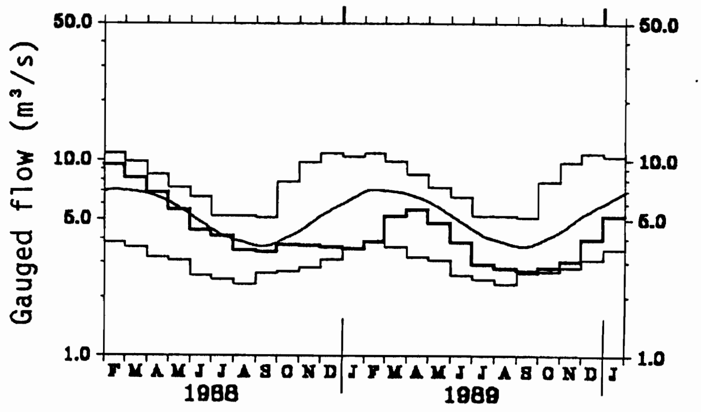
040003 Medway at Teston
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1956-1987



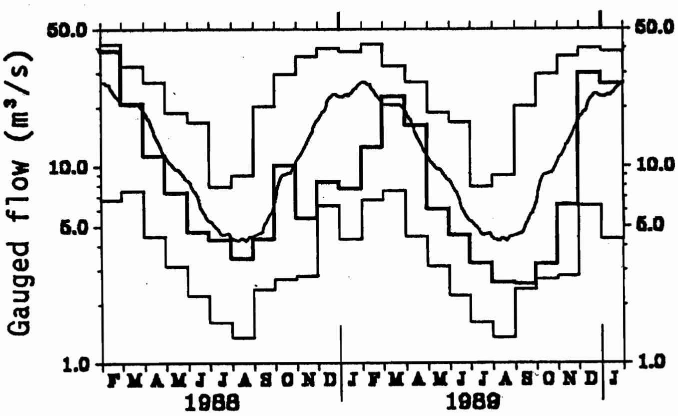
041005 Ouse at Gold Bridge
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1960-1987



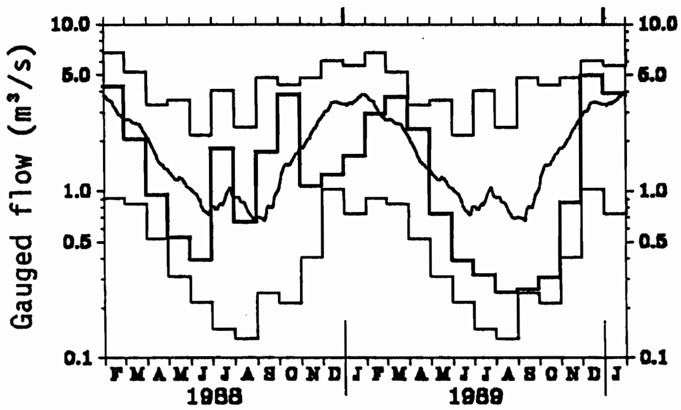
042010 Itchen at Highbridge+Allbrook
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1958-1987



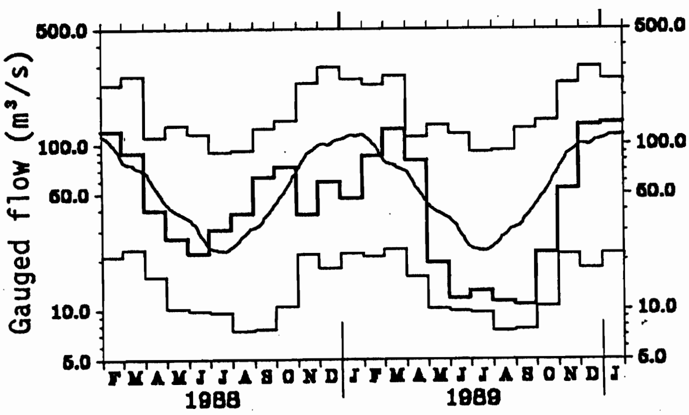
043007 Stour at Throop Mill
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1973-1987



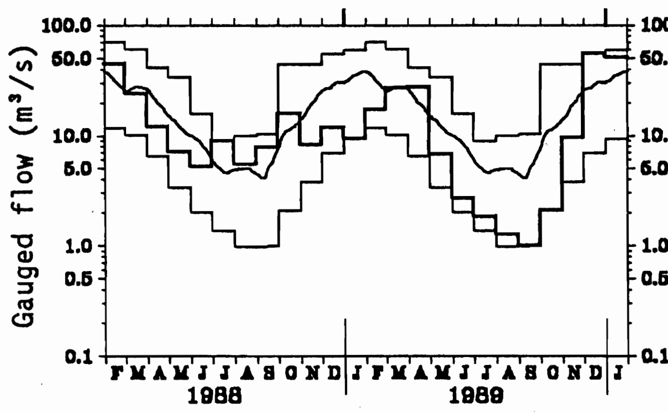
052010 Brue at Lovington
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1964-1987



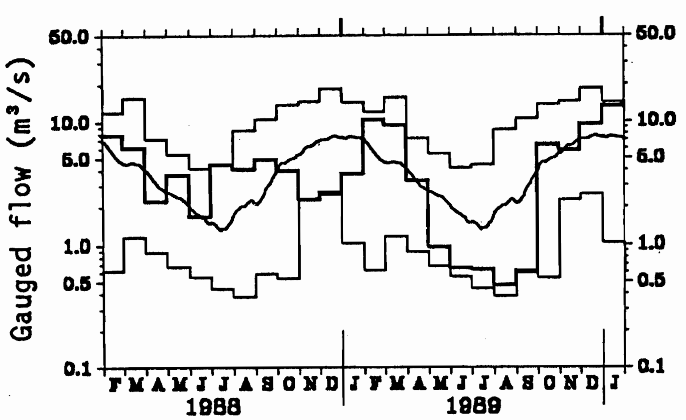
054001 Severn at Bewdley
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1921-1987



054029 Teme at Knightsford Bridge
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1970-1987



057004 Cynon at Abercynon
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1957-1987



076007 Eden at Sheepmount
Monthly mean flows for Feb 1988-Jan 1990
+ extremes and 30 day running mean for 1967-1987

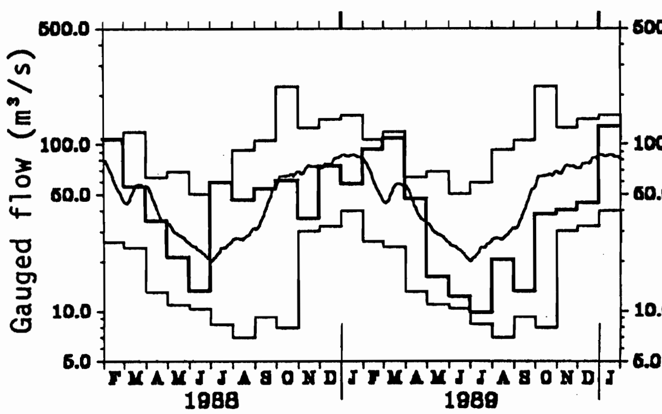


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	Jan 1989	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 1990	10/89 to 1/90 mm %LT	rank /yrs	5/89 to 1/90 mm %LT	rank /yrs	11/88 to 1/90 mm %LT	rank /yrs	10/88 to 1/90 mm %LT	rank /yrs
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT								
Dee at	79	55	116	52	48	23	11	17	29	34	37	43	79	193	2	322	1	729	1	846	1
Park	87	79	129	64	72	60	38	50	67	41	48	47	85	57	/17	59	/17	70	/17	74	/16
Tay at	192	214	239	99	47	30	22	54	69	99	106	65	201	471	15	692	9	1645	28	1863	31
Ballathie	138	201	203	120	66	66	55	104	97	89	88	45	144	91	/38	87	/37	108	/37	114	/37
Tweed at	175	94	140	55	25	16	11	27	29	32	35	60	175	301	7	409	4	913	7	992	8
Boleside	177	132	182	107	57	56	40	68	55	44	40	64	177	86	/29	76	/28	90	/28	91	/28
South Tyne at	53	89	93	55	12	9	6	19	8	55	42	83	140	320	9	374	1	807	3	873	3
Haydon Bridge	54	133	111	100	32	32	20	45	15	79	45	86	144	90	/28	68	/26	77	/26	78	/26
Wharfe at	42	64	95	71	15	13	10	14	10	39	29	44	126	238	4	300	1	713	1	790	2
Flint Mill Weir	43	87	126	131	38	51	37	33	21	60	36	45	128	71	/35	58	/34	72	/34	75	/34
Derwent at	17	17	22	29	13	9	8	6	5	6	9	15	22	52	1	94	1	230	1	252	1
Buttercrambe	33	40	47	85	50	51	58	42	37	25	35	36	43	39	/17	43	/16	50	/16	52	/16
Trent at	21	26	42	57	18	13	12	10	9	13	17	56	45	131	12	193	7	385	5	407	6
Colwick	41	60	103	177	70	67	74	59	52	54	55	127	88	88	/32	80	/31	79	/31	80	/31
Dove at	68	43	71	67	24	17	17	12	10	16	29	59	68	173	7	253	4	544	3	585	3
Marston on Dove	100	78	132	157	66	63	73	50	40	47	60	91	98	81	/29	73	/27	80	/27	81	/27
Lud at	15	12	16	17	15	12	10	9	8	9	8	12	12	41	4	96	2	187	3	201	3
Louth	47	33	42	50	52	56	59	64	69	72	53	59	38	53	/22	59	/21	56	/21	58	/21
Witham at	8	8	12	31	14	8	6	4	4	5	6	20	20	51	13	88	14	160	7	166	7
Claypole Mill	30	30	45	148	87	80	84	56	63	57	49	105	76	77	/31	78	/31	65	/30	65	/30
Colne at	13	14	23	20	6	4	5	3	5	3	5	14	11	34	6	57	6	145	6	153	7
Lexden	55	77	122	150	67	73	119	73	115	34	39	82	46	55	/31	64	/30	75	/30	76	/30
Mimram at	9	8	10	14	11	9	9	7	6	6	6	10	11	32	10	74	6	135	9	146	9
Panshanger Park	77	68	74	110	88	82	92	77	73	71	68	98	94	83	/37	83	/37	86	/36	88	/36
Thames at	13	20	36	28	13	9	7	6	6	7	9	38	33	86	44	127	36	247	22	261	23
Kingston (natr.)	35	61	115	124	74	71	74	68	67	52	41	126	88	84	/107	79	/107	74	/106	75	/106
Coln at	15	19	48	44	30	18	15	13	10	10	15	39	56	120	11	205	8	364	3	378	3
Bibury	29	35	89	101	89	66	70	76	69	61	60	98	107	91	/27	84	/26	71	/26	72	/26
Mole at	64	55	72	61	16	19	12	11	11	15	16	81	64	176	5	244	5	492	1	518	1
Kinnersley Manor	89	114	142	185	57	106	93	71	61	38	36	123	85	79	/15	79	/15	76	/13	75	/13
Medway at	7	17	27	41	7	6	4	3	4	4	5	28	33	70	7	94	4	201	1	209	1
Teston	14	46	85	185	47	60	62	41	40	21	16	69	66	51	/29	50	/26	51	/25	51	/25
Itchen at	26	26	39	40	36	27	22	21	20	21	22	29	39	111	3	236	2	420	1	448	1
Highbridge+Allbrook	53	53	74	85	84	77	71	73	75	68	63	68	79	71	/32	74	/31	71	/31	72	/31
Stour at	19	28	57	39	15	11	8	6	6	8	15	74	66	164	10	211	6	388	1	413	1
Throop Mill	31	49	110	112	62	68	70	55	49	35	46	134	106	96	/17	86	/17	71	/16	73	/16
Tone at	25	54	80	40	19	11	10	7	9	13	29	91	88	221	15	277	12	521	5	565	6
Bishops Hull	31	74	139	102	67	61	63	55	57	47	68	136	108	102	/29	90	/29	78	/28	81	/28
Brue at	77	52	73	45	15	7	6	5	5	6	16	98	77	198	11	236	4	484	2	560	5
Lovington	111	89	143	151	62	45	35	31	32	20	37	144	108	93	/25	79	/25	78	/25	86	/24
Severn at	29	48	77	48	12	7	8	7	6	14	32	81	84	210	29	250	16	511	13	556	15
Bewdley	41	84	168	152	50	39	56	40	27	41	59	130	118	95	/69	79	/69	80	/68	82	/68
Teme at	93	29	50	49	12	5	3	2	2	4	17	101	93	214	16	239	10	419	2	448	3
Knightsford Bridge	144	54	98	141	55	34	35	22	23	19	50	190	138	122	/20	101	/20	80	/19	82	/19
Yscir at	92	130	182	72	18	10	11	8	11	90	125	209	225	649	16	707	9	1288	5	1379	5
Pontaryscir	62	128	165	120	40	32	49	25	22	97	101	140	152	122	/17	101	/17	91	/16	91	/16
Cynon at	94	232	232	80	24	16	16	12	15	160	139	238	331	867	28	950	18	1711	14	1811	11
Abercynon	50	182	199	105	39	38	46	23	21	132	90	126	175	132	/32	102	/30	96	/30	95	/30
Dee at	133	215	333	129	23	34	23	34	36	226	169	224	388	1007	14	1156	5	2237	5	2393	5
New Inn	55	136	189	125	32	57	33	35	25	113	68	90	161	108	/21	84	/20	87	/20	87	/20
Lune at	94	167	196	82	20	14	12	44	13	121	81	84	266	552	13	655	3	1430	7	1559	6
Caton	64	186	203	110	39	34	23	61	14	99	60	54	182	98	/26	75	/26	91	/24	92	/24
Eden at	68	98	127	53	19	14	11	24	15	44	45	52	149	291	7	374	4	847	5	917	5
Sheepmount	67	152	194	114	56	53	39	75	33	57	53	58	147	84	/19	74	/18	89	/17	89	/17

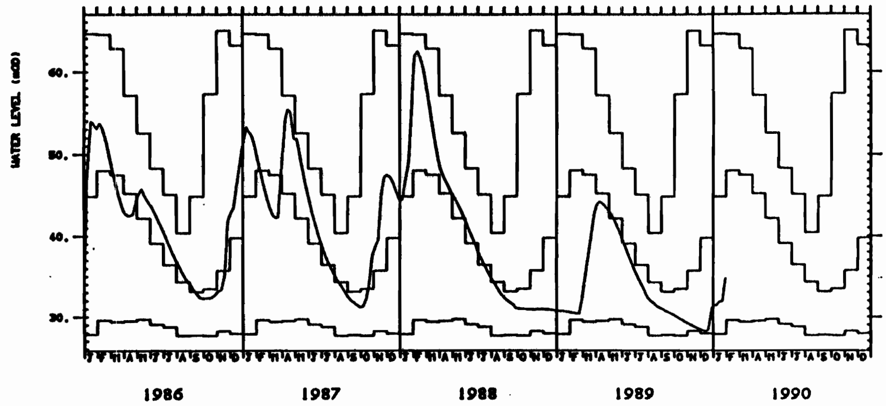
Notes
(i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that the lowest runoff is rank 1.
(iii) %LT means percentage of the long term average from the start of the record to 1988. For the long periods (at the right of this table) the end date for the long term is 1989.

FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: COMPTON HOUSE

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

Aquifer: CHALK AND UPPER GREENSAND — Measuring level: 81.37

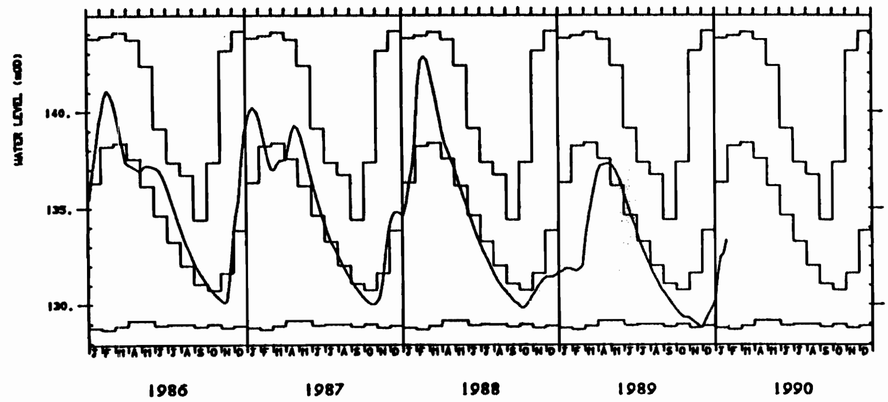


Max, Min and Mean values calculated from years 1894 TO 1989

Site name: ROCKLEY

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

Aquifer: CHALK AND UPPER GREENSAND — Measuring level: 146.39

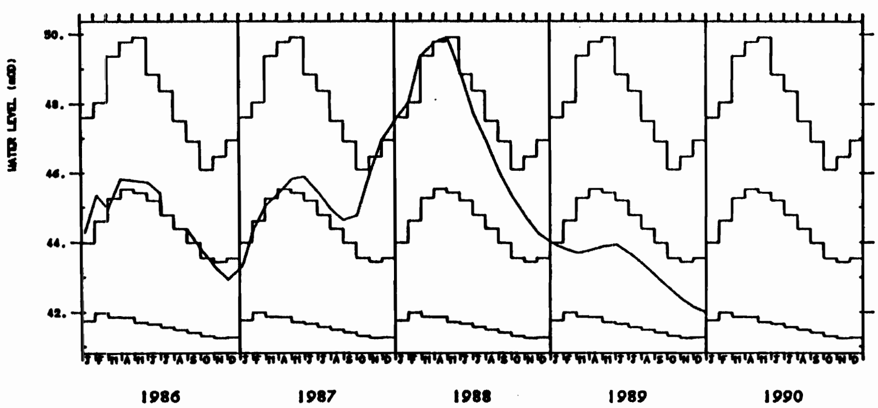


Max, Min and Mean values calculated from years 1933 TO 1989

Site name: WASHPIT FARM

National grid reference: TF 8138 1960 — Well number: TF81/2

Aquifer: CHALK AND UPPER GREENSAND — Measuring level: 80.20

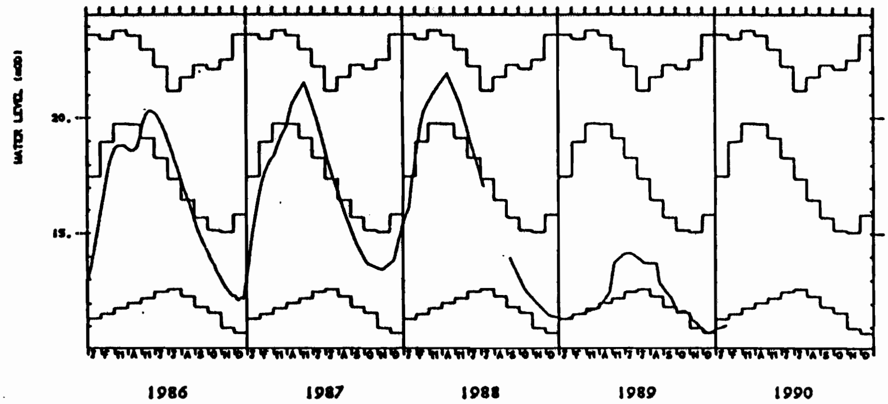


Max, Min and Mean values calculated from years 1950 TO 1989

Site name: DALTON HOLME

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

Aquifer: CHALK AND UPPER GREENSAND | Measuring level: 33.50



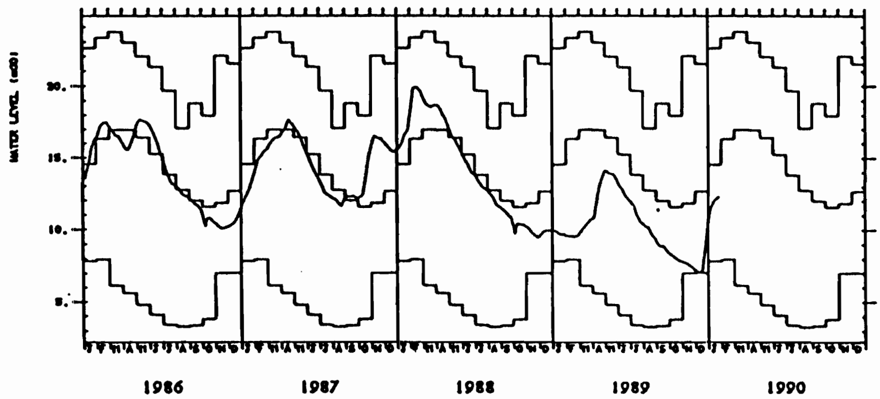
Max, Min and Mean values calculated from years 1889 TO 1989

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

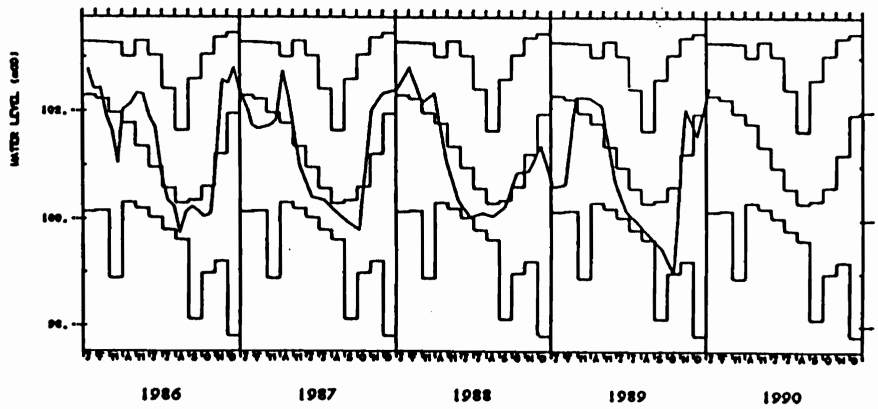


Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

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

Aquifer: MIDDLE JURASSIC | Measuring level: 109.70

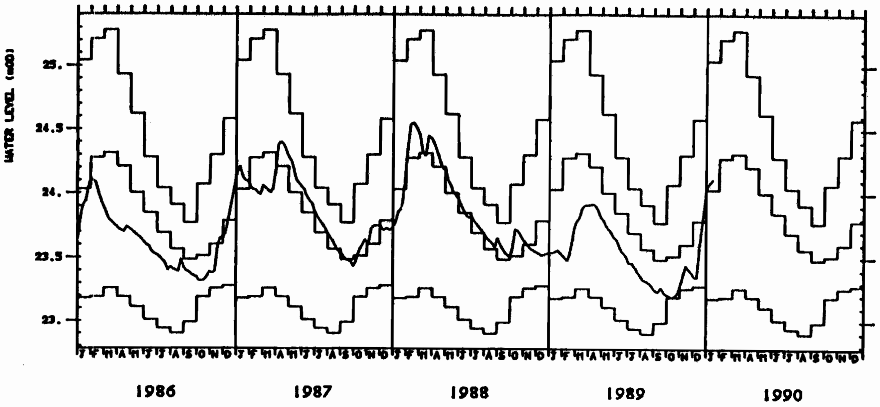


Max, Min and Mean values calculated from years 1958 TO 1989

Site name: BUSSELS NO.7A

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

Aquifer: PERMO-TRIASSIC SANDSTONE — Measuring level: 26.07

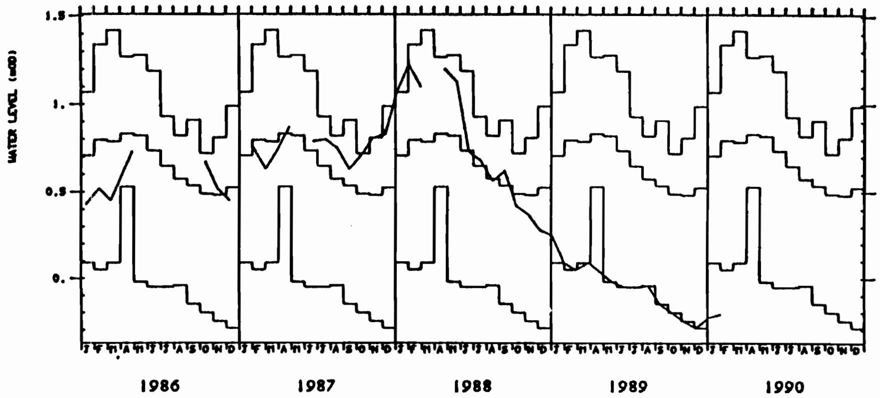


Max, Min and Mean values calculated from years 1972 TO 1989

Site name: WOODHOUSE GRANGE

National grid reference: SE 6784 0709 — Well number: SE60/76

Aquifer: PERMO-TRIASSIC SANDSTONE — Measuring level: 4.35



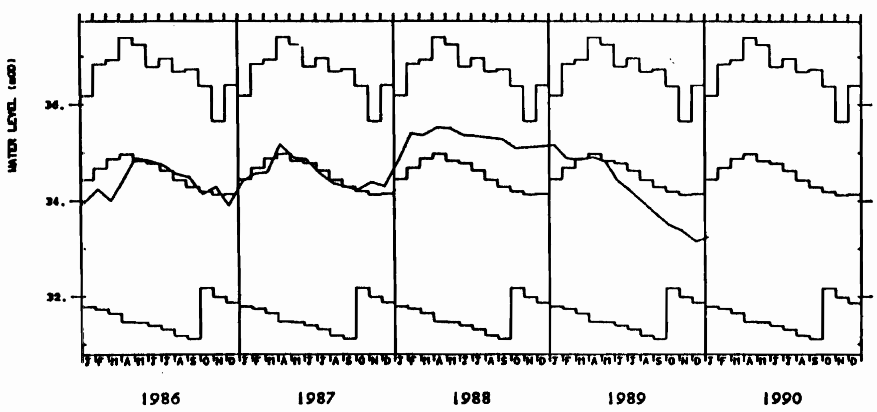
Max, Min and Mean values calculated from years 1980 TO 1989

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 1989