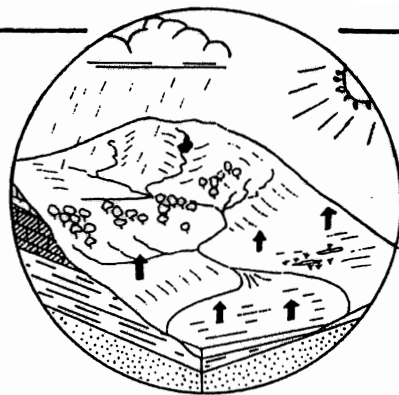


Hydrological Summary for Great Britain



SEPTEMBER 1991

Rainfall

Around 80% for GB - above average in East Anglia but below in most regions. 1991 rainfall totals are within the normal range in all regions but exceptionally large long term deficiencies persist in parts of eastern England.

River flows

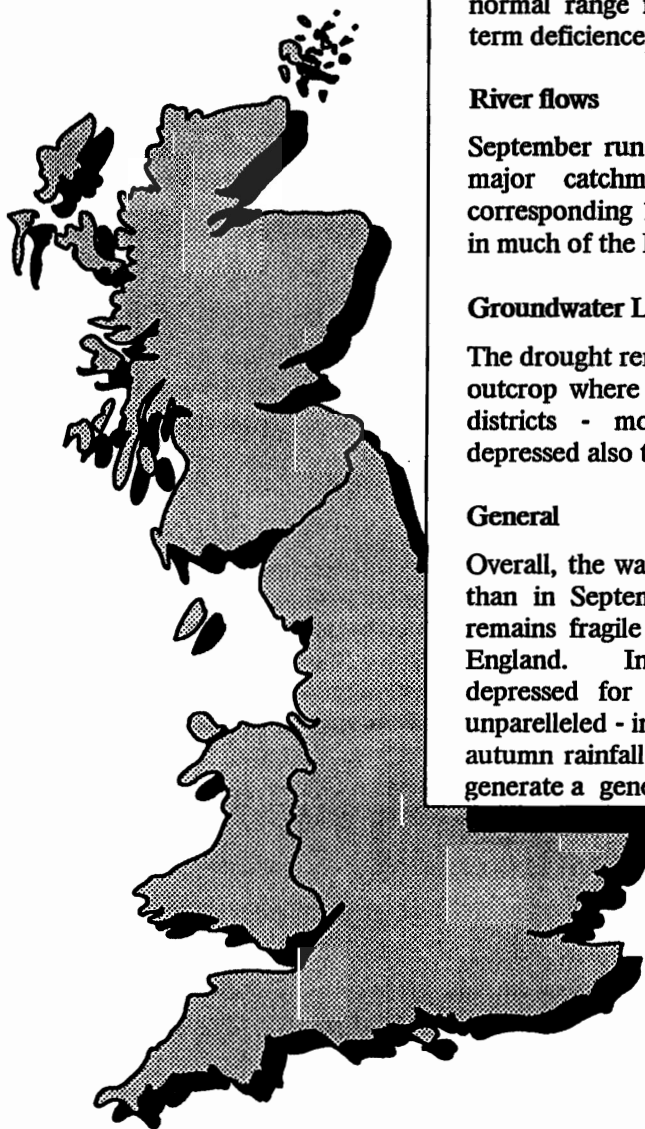
September runoff totals were below average in almost all major catchments but, in most areas, above the corresponding 1990 total. River flows are very depressed in much of the English lowlands.

Groundwater Levels

The drought remains severe over much of the eastern chalk outcrop where levels are unprecedented in a number of districts - mostly in East Anglia. Water-tables are depressed also throughout much of the Midlands.

General

Overall, the water resources outlook is more encouraging than in September 1990 but the groundwater situation remains fragile in much of eastern, and parts of central England. In some districts water-tables have been depressed for up to three years and the drought is unparalleled - in this timeframe - this century. Substantial autumn rainfall is essential to wet-up the soils and thence generate a general recovery in runoff and recharge rates.



Institute of
Hydrology



British
Geological
Survey

HYDROLOGICAL SUMMARY FOR GREAT BRITAIN

SEPTEMBER 1991

Data for this report have been provided principally by the regional divisions of the National Rivers Authority in England and Wales, the River Purification Boards in Scotland and by the Meteorological Office. Reservoir contents information for England and Wales has been supplied by the Water Companies. The most recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a proportion of the river flow data is of a provisional nature.

A map (Figure 4) is provided to assist in the location of the principal monitoring sites.

Rainfall

September was very much a month of two halves: generally dry and warm over the initial fortnight but turning increasingly autumnal thereafter; weather conditions became particularly unsettled towards month-end. Throughout large parts of the English lowlands a notable dry spell, beginning around the 7th August, continued - with only a few interludes of mostly light, patchy rainfall - for more than six weeks. Heavy and sustained frontal rainfall, with some thunder, on the 26th (when a rainfall total exceeding 50 mm was reported for an intense two-hour storm near Doncaster) and the 28th provided a dramatic termination to this dry episode in most areas. On the 28th localised flooding was widely reported in southern England when a number of districts registered precipitation totals greater than 40 mm. Spatial variations were, however, large - for instance, Poole (Dorset) recorded over 80 mm on the 28th whilst less than 5 mm was reported along the coast at Portland. Consequently the provisional regional rainfall totals presented in Table 1 should be treated with particular caution.

The September rainfall total for Great Britain as a whole was about 20 percent below average but regional variations were considerable. Some areas in Wales, northern England and Scotland recorded less than half their September average. Unusually, in relation to the recent past, the Anglian region recorded above average rainfall in September; only the ninth month in the last 43 to exceed the 1941-70 monthly mean. All the other NRA regions registered between 50 and 85 per cent of the long term average (Table 1).

Since June, parts of northern England - Yorkshire in particular - have recorded only a little over half their average rainfall and much of eastern and southern Scotland has been relatively dry also. However, rainfall totals for 1991 and for the water-year (October-September) are within the normal range in all regions. In the period from March 1990 substantial rainfall deficiencies may be recognised in the Yorkshire, Anglian and Thames regions but the obvious hydrological manifestations of the drought (see below) largely reflect the notable long-term deficiencies (see the August 88 - September 91 accumulations) which characterise much of the English lowlands (and north eastern England). An estimated return period of around 100 years is associated with the 38-month rainfall deficiency in the Anglian region; some districts have had less than 75 per cent of average rainfall in this timeframe - evidence of a remarkably sustained drought for which there is no close parallel this century.

Evaporation and Soil Moisture Deficits (SMDs)

Temperatures and sunshine hours for September were well above average throughout most of Britain, notably so in the west. Consequently potential evaporation (PE) losses were very high - in some areas eclipsing the corresponding totals for 1990 which themselves were commonly the highest in the thirty-year MORECS series. Actual evaporation (AE) losses were constrained by the dry soils and, in the lowlands particularly, were well below average.

For the year thus far, PE totals are close to the average - in marked contrast to 1989 and 1990. AE losses are mostly well below average albeit greater than in 1976 or 1990.

Soil moisture deficits continued to build well into September but declined sharply over the final week, reductions of 40 mm being common in southern Britain but local variations were large. At month-end, SMDs presented only a limited degree of spatial coherence but in a broad zone from Shropshire through northern England and eastern Scotland, soils were generally much drier than the early autumn average. Conversely, in parts of Lincolnshire deficits were up to 50 mm below average. Generally, deficits in southern Britain and especially in the regions where the drought is most severe, were substantially less than at the same time in 1990.

Throughout parts of the Midlands and much of eastern England (extending north along the Scottish seaboard) SMDs are the equivalent of 6-8 weeks of average rainfall. The pace at which these deficits are eliminated through the autumn will heavily influence the water resource outlook for 1992.

Runoff

Abundant surface water - on roads especially - and very localised flooding in a number of localities England late in September contrasted sharply with runoff conditions throughout the greater part of the month. Sustained recessions typified most rivers until mid-month at least and early autumn flows, in the east particularly, were depressed for the third year in succession.

With few exceptions, runoff totals for September were below average - substantially so in most regions. Many rivers in eastern England registered September mean flows amongst their lowest three or four on record; notably modest September runoff totals extended well beyond the lowlands. The Dee (Grampian region) at the Park gauging station and the Derbyshire Derwent (where compensation flows and abstractions significantly modify low flows) were among a number of rivers to establish new September runoff minima.

For many rivers, particularly in eastern England, the September runoff was greater than in 1990 - and often 1989 also - but considerably lower than any registered over the preceding decade at least. The recent clustering of years with notably low early autumn flows is well illustrated on the Yorkshire Derwent where the three lowest September runoff totals, in a 30-year record, have been registered since 1988. Similarly on the Thames, only in 1976 have comparable naturalised September flows to those of 1989, 1990 and 1991 been recorded since the 1959 drought. In many lowland rivers, especially those with flow records commencing after the dry years of the early and mid-1970s, the low flow statistics (e.g. the 95 per cent exceedence flow) have been largely redefined over the last three years.

Accumulated runoff totals for the summer half-year, for 1991 thus far and for the water-year (October-September - see Table 3) are within the normal range, albeit appreciably below average, throughout most of western and northern Britain. In the English lowlands however, water-year runoff

totals are the lowest, or close to the lowest, on record (see, for instance, figures for the Lud, Trent and Little Ouse) and the longer term accumulations testify to a runoff deficiency of an exceptional magnitude - unprecedented in parts of East Anglia, Yorkshire and the Thames Valley. Runoff over the period August 1988 to September 1991 is the lowest for ANY 38-month sequence in the flow records for the Little Ouse and the Lud; 38-month accumulations ending in September 1991 for the Stour (Stour) and Itchen are less outstanding but nonetheless are below any previously recorded.

As is normal in September, reservoir replenishment was very modest and stocks declined considerably through the month. Stocks remain healthy in the west, however, and - apart from northern England - storages are considerable greater than at the beginning of October in 1990.

Groundwater

In general, groundwater levels continued to fall through September within the outcrop areas of all the major aquifers. At some monitoring sites, end-of-month levels were not available when this report was prepared, and it is possible that small rises in groundwater levels may have occurred in the more heavily fissured aquifers such as the Middle Jurassic oolites in response to the heavy rainfall at the end of the month.

The effects of the droughts of 1989 and 1990 ensured that the summer recession of 1991 started at levels generally much below normal in eastern areas with groundwater levels in the Chalk remaining very depressed east of a line from the Humber to Sussex. At Washpit Farm the groundwater level on the first of October 1991 is the lowest ever recorded in a 40-year period. At Redlands levels are in a relatively steep decline and already below the pre-1991 minimum, a situation closely approached at the Fairfields site. Further west, levels are well below the seasonal norm at the New Red Lion site (Lincolnshire Limestone aquifer), below the bottom of the well at Weeford Flats (Permo-Triassic sandstone), and near the seasonal minima at Alstonfield (Carboniferous Limestone) and Lanfair DC (Permo-Triassic sandstone). The region of particularly low groundwater level has extended through the late summer and early autumn to embrace large parts of the Midlands. Nonetheless, Table 5 demonstrates that the most severe groundwater depletion remains in a zone from Lincolnshire to parts of Kent.

Across southern England, groundwater levels, while still falling, nonetheless remain above the seasonal minima. At the West Woodyates Manor site in the Chalk of Wessex, the level has risen appreciably by the end of September, but it is not certain whether this is in response to late-September rainfall or to some other cause.

In northern England, levels are generally near or somewhat below the seasonal means, but are still falling. Data from the Redbank site in the Triassic sandstones of the Mauchline Basin in Scotland suggest that levels are very depressed; unfortunately, a long gap in the records from 1989 through much of 1990 prevents comparison with the summer months of those years.

The heavy rainfall over most outcrop areas in late September has encouraged the prospect of a much earlier onset of the seasonal recovery in groundwater levels than in the last three years. However, rainfall will need to be substantially above average throughout the rest of the autumn to generate a sustainable recovery and, thereafter, a wet winter in the lowlands will be essential if groundwater levels are to return to within their normal range by the spring of 1992.

TABLE 1 1990/91 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Aug 1990	Sep	Oct	Nov	Dec	Jan 1991	Feb	Mar	Apr	May	June	July	Aug	Sept 1991
England and Wales	mm	46	53	103	67	101	92	65	75	68	14	92	69	30	65
	%	51	64	124	69	112	107	100	127	117	21	151	95	33	79
NRA REGIONS															
North West	mm	73	86	175	73	151	98	94	110	61	16	96	65	65	69
	%	58	70	148	60	126	88	116	153	79	20	116	63	52	56
Northumbria	mm	53	53	107	61	127	83	113	85	40	23	73	55	37	43
	%	52	66	143	65	169	104	171	163	73	36	120	71	37	54
Severn-Trent	mm	37	46	93	52	87	77	43	59	66	11	74	77	21	53
	%	46	69	143	66	124	112	81	113	127	17	132	118	26	80
Yorkshire	mm	47	39	92	55	121	71	88	63	49	15	74	37	21	47
	%	52	54	133	62	164	92	138	119	88	24	128	53	23	65
Anglian	mm	31	32	51	53	47	44	39	29	44	13	77	38	18	64
	%	48	62	98	85	89	85	93	73	110	28	157	67	28	123
Thames	mm	35	34	58	34	68	80	38	45	62	14	96	79	19	53
	%	50	55	91	47	103	129	81	98	135	25	185	132	27	85
Southern	mm	33	38	105	63	65	98	39	59	56	17	125	87	15	51
	%	45	54	135	67	80	129	68	113	117	31	250	147	21	71
Wessex	mm	41	49	87	51	78	108	40	81	69	9	106	73	20	63
	%	50	62	106	53	87	129	68	140	128	13	196	118	24	80
South West	mm	59	69	128	106	124	153	82	127	99	10	127	91	32	82
	%	58	66	113	79	92	119	91	151	139	12	195	108	32	79
Welsh	mm	64	85	152	112	163	151	94	127	121	15	110	98	53	76
	%	54	68	118	78	112	111	98	146	141	16	134	103	45	61
Scotland	mm	119	149	213	102	191	151	83	127	121	43	121	92	67	122
	%	92	109	143	72	122	110	80	138	134	47	132	82	52	89
RIVER PURIFICATION BOARDS															
Highland	mm	156	234	225	147	241	180	71	141	129	67	124	108	84	179
	%	105	148	121	87	123	110	53	124	113	66	113	85	57	113
North-East	mm	75	86	136	95	97	60	77	81	59	48	128	57	33	71
	%	70	99	140	92	95	66	104	131	97	61	183	62	31	82
Tay	mm	73	68	186	63	149	154	90	117	107	22	136	91	41	109
	%	62	59	152	53	111	131	98	143	143	23	164	89	35	95
Forth	mm	83	68	194	56	143	133	86	103	90	19	108	96	39	97
	%	72	63	183	52	131	134	112	149	132	22	144	98	34	90
Tweed	mm	61	69	159	53	152	110	102	93	60	20	89	65	35	69
	%	54	74	181	51	169	118	148	160	98	21	131	73	31	74
Solway	mm	106	81	218	77	191	144	108	150	146	18	121	77	69	89
	%	82	54	151	53	126	103	116	165	166	17	134	70	53	59
Clyde	mm	151	172	301	94	226	187	90	156	181	35	129	110	86	135
	%	106	98	164	56	122	116	80	149	176	36	125	85	61	77

Note: The most recent monthly rainfall figures for England and Wales correspond to the MORECS areal assessments derived by the Meteorological Office; for the Scottish RPBs the September 1991 totals were estimated from the isohyetal map provided with the MORECS bulletin. The regional areal rainfall figures are regularly updated (normally one or two months in arrears) using figures derived from a far denser raingauge network.

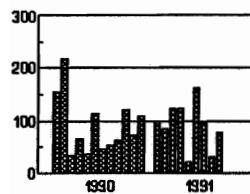
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		JAN - SEP 91		OCT 90 - SEP 91		MAR 90 - SEP 91		AUG 88 - SEP 91	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	571		842		1134		2549	
	% LTA	89	2-5	92	2-5	81	30-40	88	15-25
NRA REGIONS									
North West	mm	674		1073		1540		3536	
	% LTA	79	10-15	88	5-10	82	15-25	91	5-10
Northumbria	mm	552		847		1170		2388	
	% LTA	87	2-5	96	2-5	86	5-15	85	30-40
Severn-Trent	mm	481		713		953		2141	
	% LTA	86	2-5	92	2-5	79	30-40	87	20-30
Yorkshire	mm	465		733		1012		2239	
	% LTA	77	10-20	88	2-5	78	40-50	84	40-60
Anglian	mm	366		517		711		1568	
	% LTA	83	5-10	85	5-10	74	80-120	81	80-120
Thames	mm	486		646		833		1894	
	% LTA	97	2-5	92	2-5	76	40-50	84	30-40
Southern	mm	547		780		989		2141	
	% LTA	101	<u>2-5</u>	98	2-5	82	10-20	85	20-30
Wessex	mm	569		785		1029		2413	
	% LTA	95	2-5	90	2-5	78	25-35	87	10-20
South West	mm	803		1161		1545		3548	
	% LTA	99	2-5	97	2-5	86	5-10	94	2-5
Welsh	mm	845		1272		1691		3947	
	% LTA	92	2-5	95	2-5	84	10-20	93	5-10
Scotland	mm	927		1433		2301		5078	
	% LTA	94	2-5	100	<2	106	<u>2-5</u>	111	<u>20-30</u>
RIVER PURIFICATION BOARDS									
Highland	mm	1083		1696		2918		6454	
	% LTA	92	2-5	98	2-5	112	<u>5-15</u>	118	<u>>200</u>
North-East	mm	614		942		1437		2888	
	% LTA	85	2-5	92	2-5	91	5-10	89	15-25
Tay	mm	867		1265		1855		4219	
	% LTA	99	2-5	101	<u>2-5</u>	96	2-5	106	<u>2-5</u>
Forth	mm	771		1164		1725		3756	
	% LTA	97	2-5	104	<u>2-5</u>	99	2-5	105	<u>2-5</u>
Tweed	mm	643		1007		1424		2945	
	% LTA	89	2-5	100	<2	91	5	92	5-10
Solway	mm	922		1408		2032		4611	
	% LTA	94	2-5	99	2-5	93	2-5	101	<u>2-5</u>
Clyde	mm	1109		1730		2766		6136	
	% LTA	98	2-5	104	<u>2-5</u>	110	<u>5-10</u>	115	<u>60-90</u>

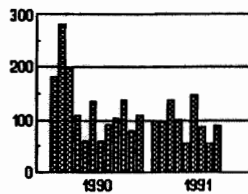
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a given month; return periods for a start in any month may be expected to be an order of magnitude less. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

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

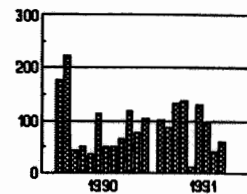
FIGURE 1. MONTHLY RAINFALL FOR 1990-1991 AS A PERCENTAGE OF THE 1941-1970 AVERAGE



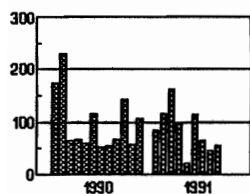
England and Wales



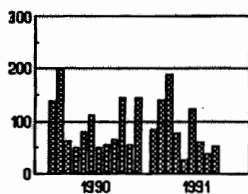
Scotland



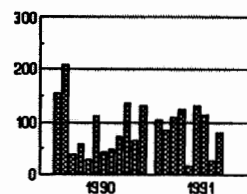
**Welsh
Region**



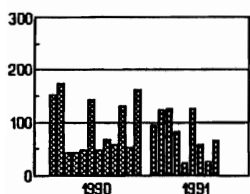
**North West
Region**



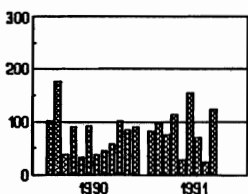
**Northumbria
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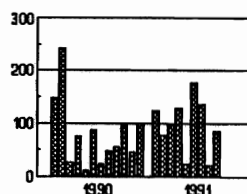
**Severn-Trent
Region**



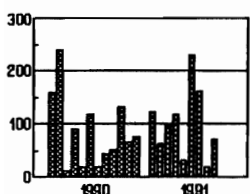
**Yorkshire
Region**



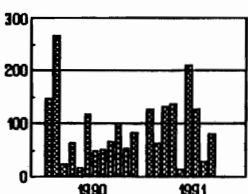
**Anglian
Region**



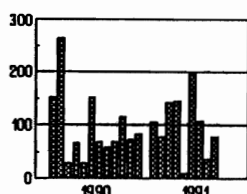
**Thames
Region**



**Southern
Region**



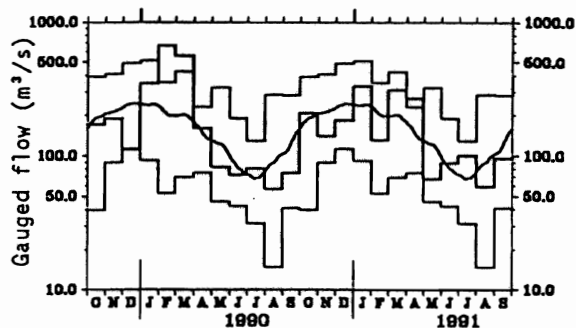
**Wessex
Region**



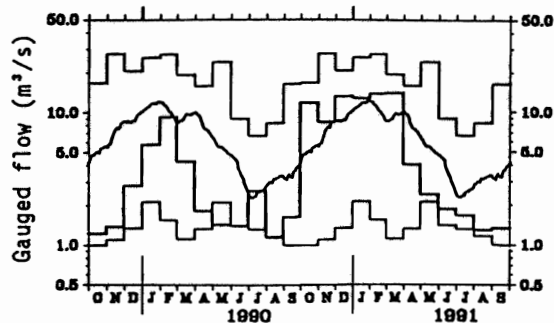
**South West
Region**

FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

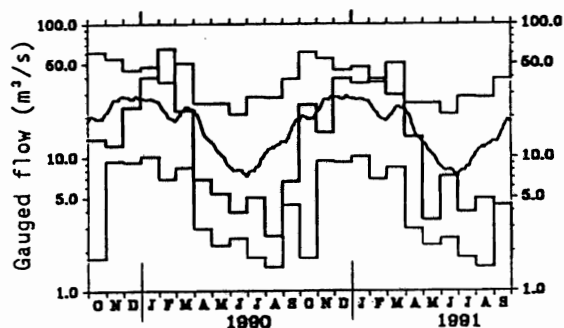
015006 Tay at Ballathie
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1952-1988



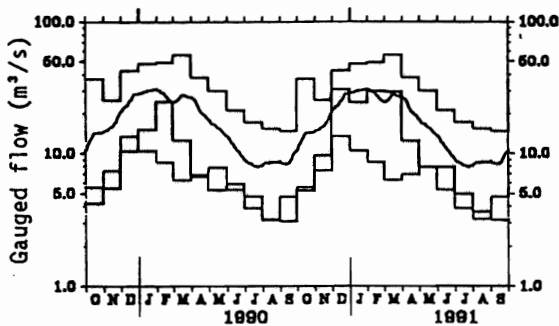
02102 Whiteadder Water at Hutton Castle
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1969-1988



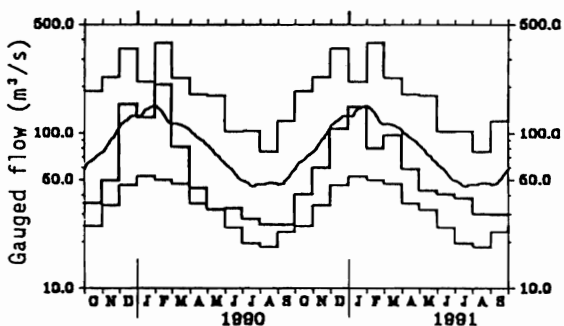
023004 South Tyne at Haydon Bridge
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1962-1988



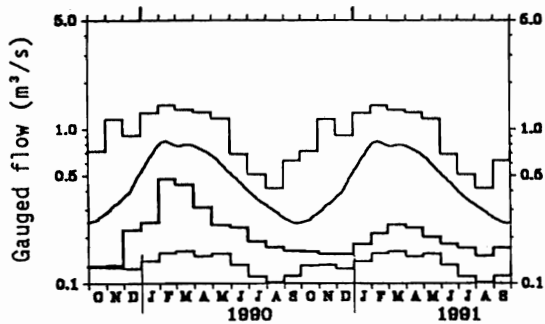
027041 Derwent at Buttercrambe
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1973-1988



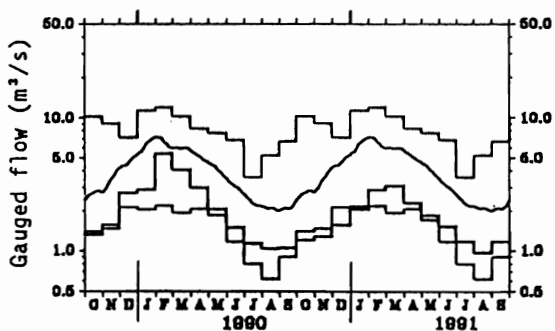
028009 Trent at Colwick
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1958-1988



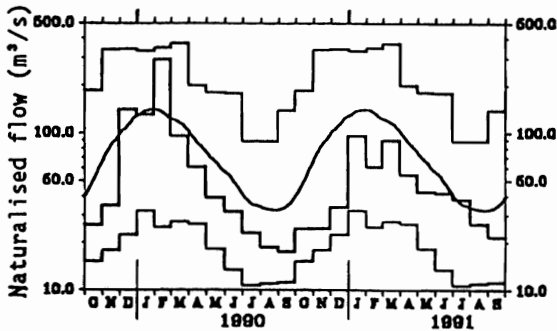
029003 Lud at Louth
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1968-1988



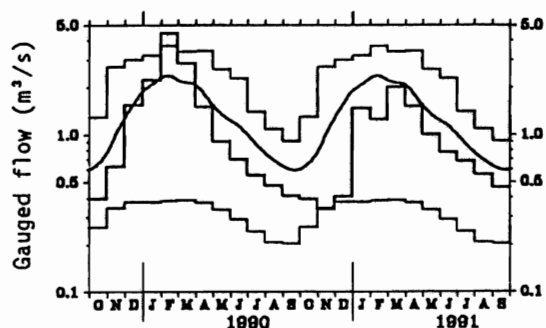
033034 Little Ouse at Abbey Heath
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1968-1988



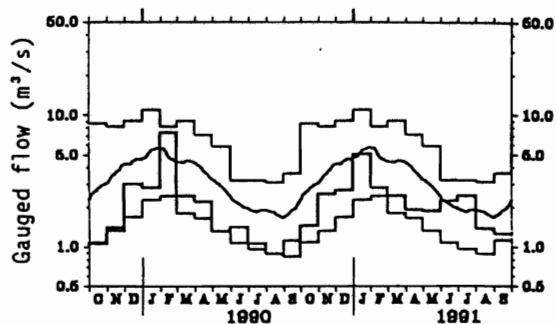
039001 Thames at Kingston
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1883-1988



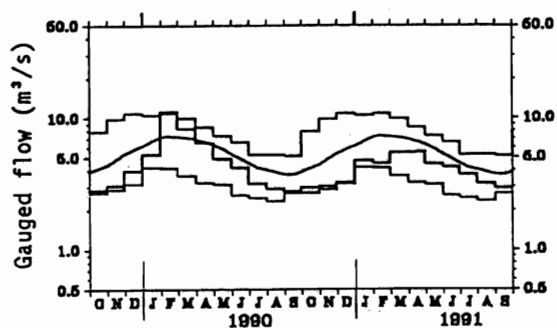
039020 Coln at Bibury
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1963-1988



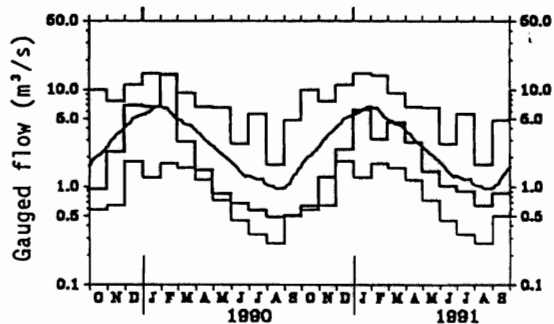
040011 Great Stour at Horton
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1964-1988



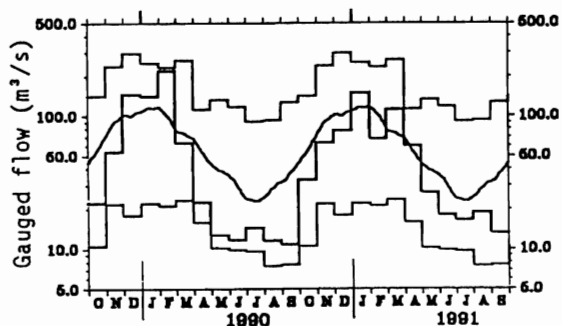
042010 Itchen at Highbridge+Allbrook
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1958-1988



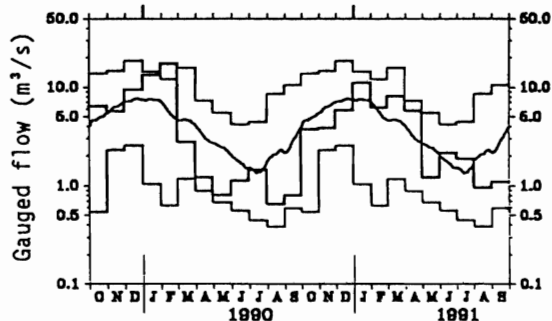
052005 Tone at Bishops Hull
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1961-1988



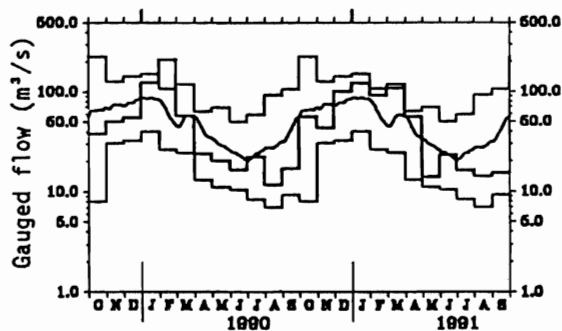
054001 Severn at Bewdley
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1921-1988



057004 Cynon at Abercynon
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1957-1988



076007 Eden at Sheepmount
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1967-1988



084013 Clyde at Daldowie
Monthly mean flows for Oct 1989-Sep 1991
+ extremes and 30 day running mean for 1963-1988

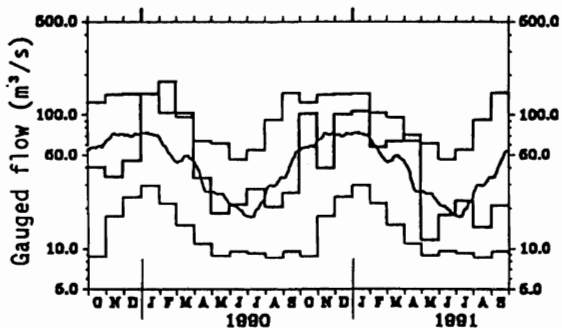


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	May 1991	Jun	Jul	Aug	Sep 1991		1/91 to 9/91		10/90 to 9/91		5/89 to 9/91		8/88 to 9/91	
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at Park	41 65	56 153	42 149	17 53	17 41	1 /19	543 101	8 /19	750 94	8 /18	1506 84	2 /17	2150 86	/1
Tay at Ballathie	39 56	50 111	58 146	34 66	54 77	15 /39	830 111	30 /39	1137 102	22 /39	2800 111	30 /37	4211 121	3 /3
Whiteadder Water at Hutton Castle	13 48	10 57	9 70	7 45	7 44	4 /23	272 96	9 /22	447 114	15 /22	668 76	6 /20	917 75	/1
South Tyne at Haydon Bridge	12 34	25 93	14 48	17 43	15 29	2 /28	488 100	15 /28	765 102	15 /28	1524 89	5 /24	2117 88	/2
Wharfe at Flint Mill Weir	13 34	24 97	18 67	15 37	15 34	5 /36	425 89	10 /36	641 90	10 /36	1288 80	2 /34	1936 86	/3
Derwent at Buttercrambe	13 54	13 77	8 56	6 42	5 37	2 /30	201 84	10 /30	277 84	9 /30	484 65	2 /28	673 65	/2
Trent at Colwick	15 60	14 74	14 88	11 66	10 60	6 /33	198 77	2 /33	271 76	2 /33	626 77	2 /31	873 79	/3
Lud at Louth	10 37	8 39	8 49	7 51	8 71	7 /24	82 38	2 /23	105 40	2 /23	295 49	1 /21	429 53	/2
Witham at Claypole Mill	9 57	7 72	5 71	4 57	5 81	13 /33	98 68	7 /32	116 63	7 /32	294 71	6 /31	384 67	/3
Little Ouse at Abbey Heath	7 47	6 55	4 48	4 52	4 54	3 /24	63 47	2 /23	78 45	1 /23	215 55	1 /22	347 65	/2
Colne at Lexden	5 57	5 93	4 96	3 74	3 71	4 /32	52 53	4 /32	66 49	5 /32	189 63	2 /30	296 71	/2
Thames at Kingston (natr.)	11 63	11 87	10 106	7 80	6 67	26 /109	124 ⁺ 68	20 /109	146 59	12 /108	424 77	20 /107	577 76	1 /10
Blackwater at Swallowfield	15 78	16 108	15 131	11 96	11 84	19 /39	171 91	14 /39	214 82	12 /39	567 94	13 /37	765 93	1 /3
Coln at Bibury	25 75	19 71	17 81	14 83	11 78	7 /28	239 76	5 /28	266 68	5 /28	754 83	6 /26	955 78	/2
Great Stour at Horton	15 70	17 110	19 135	11 82	9 65	5 /27	162 76	5 /25	214 72	6 /24	455 67	1 /22	608 65	/2
Itchen at Highbridge+Allbrook	33 78	30 86	27 89	23 82	21 80	5 /33	279 78	5 /33	347 75	3 /33	895 82	1 /31	1157 80	/3
Stour at Throop Mill	20 85	14 90	14 128	9 88	8 69	6 /19	245 88	4 /19	282 72	3 /18	763 88	5 /17	994 82	/1
Piddle at Bagss Mill	28 88	23 99	21 118	15 97	16 106	22 /28	268 86	6 /27	308 77	4 /27	780 85	5 /24	989 79	/2
Exe at Thorverton	22 58	24 101	32 155	15 53	14 36	8 /36	496 95	12 /35	739 89	8 /35	1550 86	6 /34	2218 87	/3
Tone at Bishops Hull	19 69	13 74	12 78	8 65	11 72	13 /31	279 83	7 /30	335 71	4 /30	879 84	5 /29	1203 82	/2
Severn at Bewdley	16 68	11 63	10 71	12 70	8 37	12 /71	289 96	29 /70	394 87	19 /70	866 87	13 /69	1237 89	1 /6
Wye at Cefn Brwyn	34 35	96 114	107 98	178 125	102 62	9 /39	1301 99	16 /36	2081 101	18 /36	4494 94	9 /27	6330 97	1 /2
Cynon at Abercynon	31 52	53 131	47 138	24 48	27 40	8 /33	945 121	28 /33	1279 103	16 /33	2842 103	15 /29	3920 101	1 /2
Dee at New Inn	22 33	67 115	63 94	54 59	43 32	5 /23	902 81	4 /22	1601 89	6 /22	3523 86	2 /20	5195 91	/2
Eden at Sheepmount	16 49	26 103	19 70	16 52	17 39	4 /21	521 115	17 /21	751 108	14 /20	1558 102	9 /17	2217 105	/1
Clyde at Daldowie	16 46	24 91	32 117	20 49	28 49	8 /28	528 109	24 /28	866 114	21 /28	1925 112	23 /26	2733 115	2 /2

Notes (i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.

(ii) Values are ranked so that lowest runoff as rank 1;

(iii) %LT means percentage of long term average from the start of the record to 1991. For the long periods (at the right of this table), the end date for the long term is 1991.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO OCTOBER 1991

Area	Reservoir (R)/ Group (G)	Capacity [●] (MI)	May	1991					Oct	〔 1990 Oct 〕
				Jun (%) [▲]	Jul	Aug	Sep			
North West	Northern Command Zone ¹	(G) 133375	90	72	68	55	43	33	34	
	Vyrnwy	(R) 55146	96	88	86	83	85	71	39	
Northumbria	Teesdale ²	(G) 87936	82	64	61	52	39	31	55	
	Kielder	(R) 199175*						85*	70*	
Severn-Trent	Clywedog	(R) 44922	97	98	99	94	91	74	45	
	Derwent Valley ³	(G) 39525	91	78	74	66	53	35	27	
Yorkshire	Washburn ⁴	(G) 22035	91	80	72	59	46	36	37	
	Bradford supply ⁵	(G) 41407	92	76	76	65	50	38	35	
Anglian	Grafham	(R) 58707	91	96	96	95	88	81	65	
	Rutland	(R) 130061	80	85	80	81	70	68	64	
Thames	London ⁶	(G) 206232	91	90	91	90	80	66	53	
	Farmoor ⁷	(G) 13843	100	100	100	100	89	82	60	
Southern	Bewl	(R) 28170	77	65	73	75	73	62	32	
	Ardingly	(R) 4627	100	100	100	100	81	84	55	
Wessex	Clatworthy	(R) 5364*	95*	84*	71*	59*	47*	40*	48*	
	Bristol WW ⁸	(G) 36620	95	91	79	71	57	46	31	
South West	Colliford	(R) 28540	94	91	89	90	86	81	67	
	Roadford	(R) 34500	98	98	94	95	89	84	50 ⁹	
	Wimbleball ¹⁰	(R) 21320	84	81	75	73	63	52	35	
	Stithians	(R) 5205	96	83	77	66	53	40	22	
Welsh	Celyn + Brenig	(G) 131155	99	96	94	89	79	68	53	
	Brianne	(R) 62140	97	88	93	93	92	84	67	
	Big Five ¹¹	(G) 69762	96	87	94	92	92	69	28	
	Elan Valley ¹²	(G) 99106	97	91	91	87	85	77	52	

● Live or usable capacity (unless indicated otherwise)

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

* Gross storage/percentage of gross storage

1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. Lower Thames (includes Queen Mother, Wraysbury, Queen Mary, King George VI and Queen Elizabeth II) and Lee Valley (includes King George and William Girling) groups – pumped storages.
7. Farmoor 1 and 2 - pumped storages.
8. Blagdon, Chew Valley and others.
9. The new Roadford reservoir was still filling after impounding.

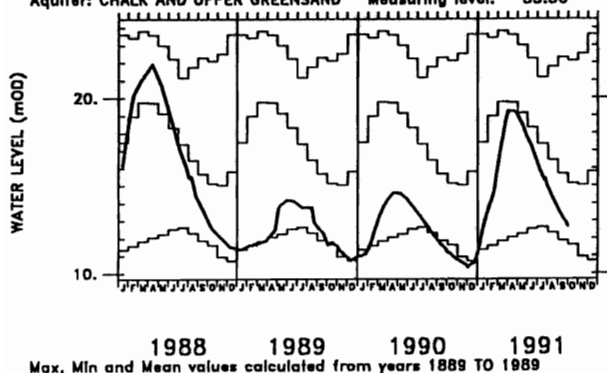
10. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
11. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
12. Claerwen, Caban Coch, Pen y Garreg and Craig Goch.

Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 provides a link between the hydrological conditions described elsewhere in the report and the water resources situation.

FIGURE 3 GROUNDWATER HYDROGRAPHS

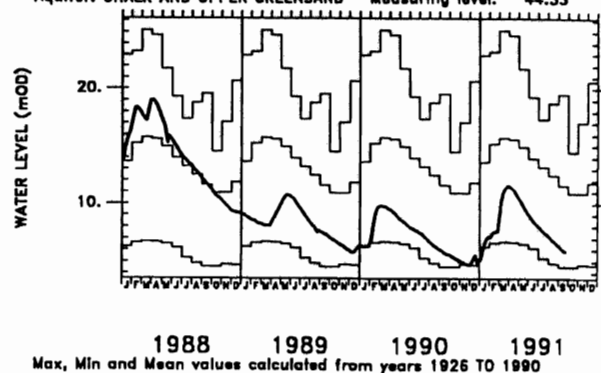
Site name: DALTON HOLME

National grid reference: SE 9651 4530 Well number: SE94/5
 Aquifer: CHALK AND UPPER GREENSAND Measuring level: 33.50



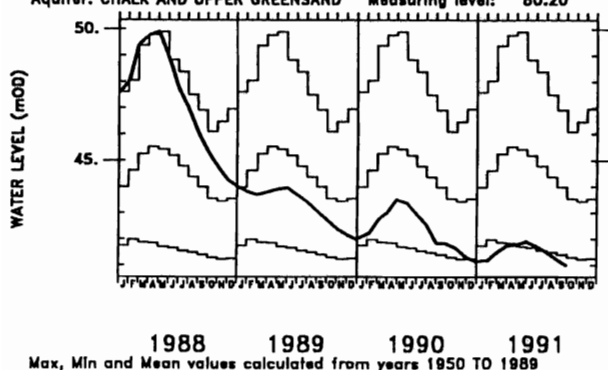
Site name: LITTLE BROCKLESBY

National grid reference: TA 1371 0888 Well number: TA10/40
 Aquifer: CHALK AND UPPER GREENSAND Measuring level: 44.33



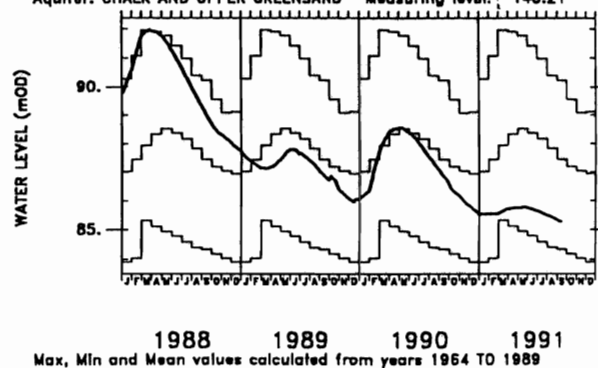
Site name: WASHPIT FARM

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



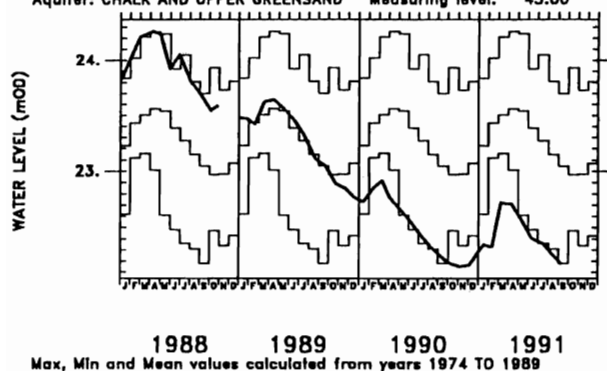
Site name: THE HOLT

National grid reference: TL 1692 1965 Well number: TL11/9
 Aquifer: CHALK AND UPPER GREENSAND Measuring level: 140.21



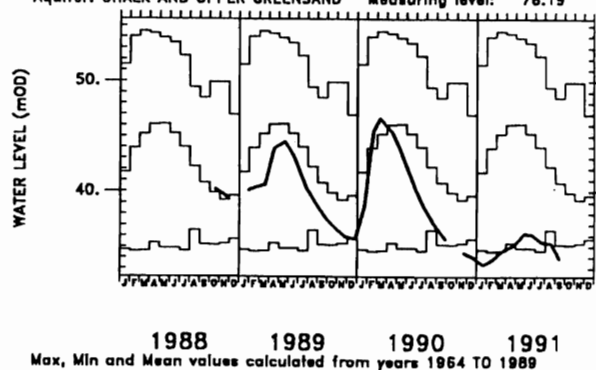
Site name: FAIRFIELDS

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



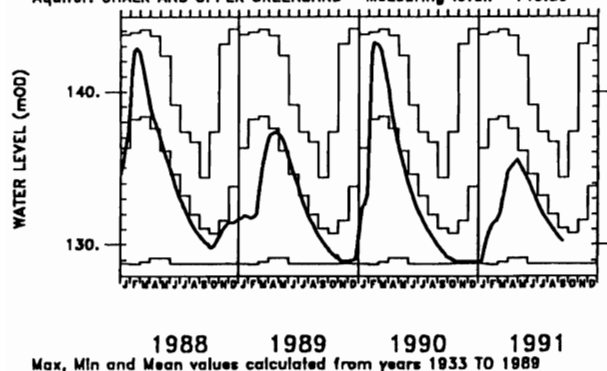
Site name: REDLANDS HALL, ICKLETON

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



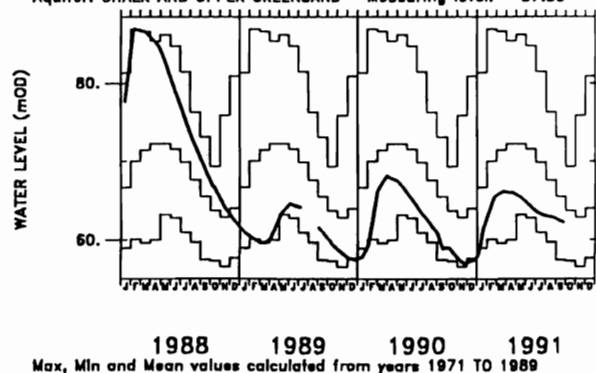
Site name: ROCKLEY

National grid reference: SU 1655 7174 Well number: SU17/57
 Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.39



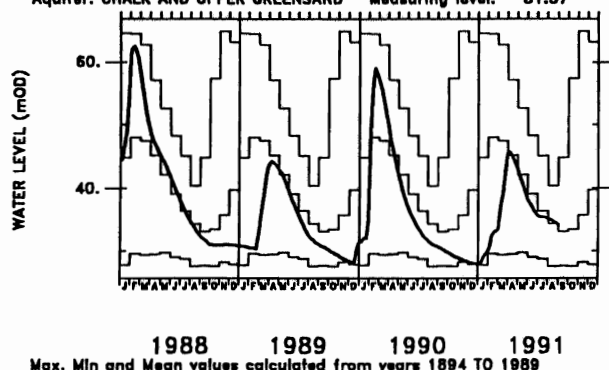
Site name: LITTLE BUCKET FARM, WALTHAM

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



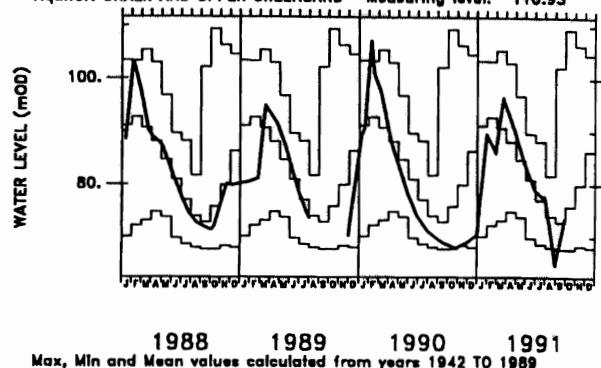
Site name: COMPTON HOUSE

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



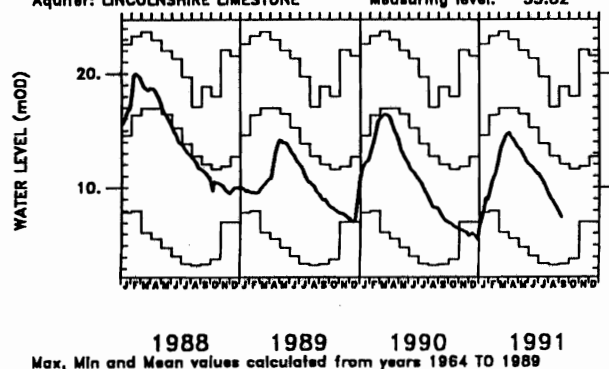
Site name: WEST WOODYATES MANOR

National grid reference: SU 0160 1960 Well number: SU01/58
 Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.93



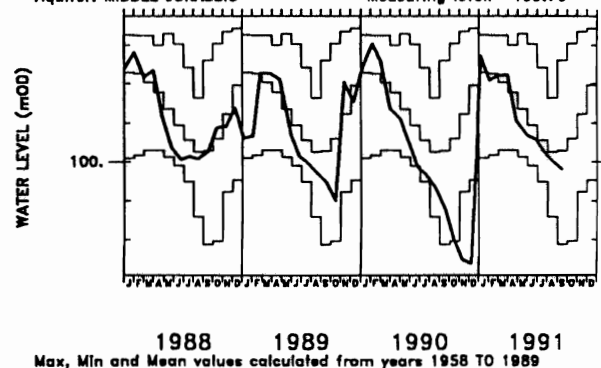
Site name: NEW RED LION

National grid reference: TF 0885 3034 Well number: TF03/37
 Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.82



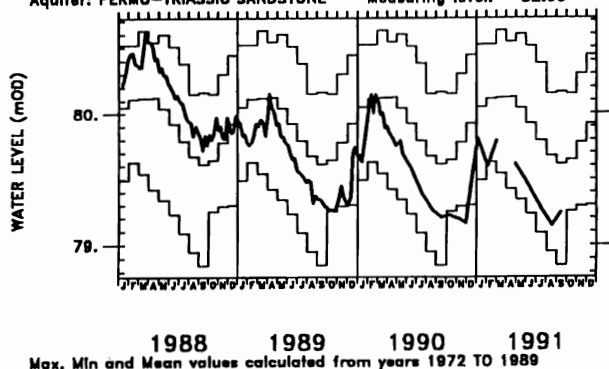
Site name: AMPNEY CRUCIS

National grid reference: SP 0595 0190 Well number: SP00/62
 Aquifer: MIDDLE JURASSIC Measuring level: 109.70



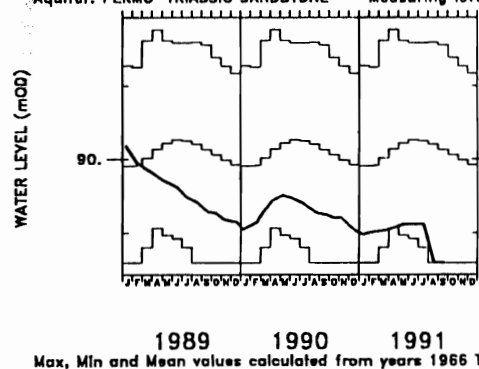
Site name: LLANFAIR DC

National grid reference: SJ 1374 5556 Well number: SJ15/15
 Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 82.00



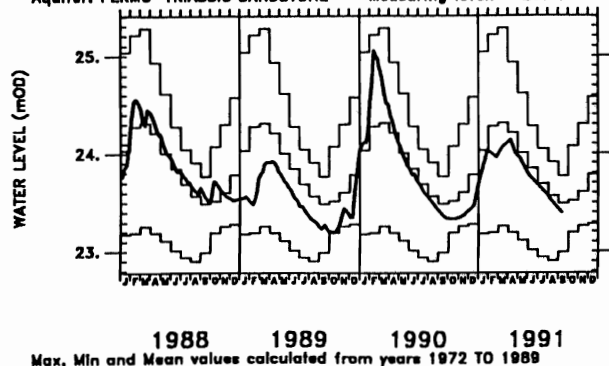
Site name: WEEFORD FLATS, WEEFORD

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



Site name: BUSSELS NO.7A

National grid reference: SX 9528 9872 Well number: SX89/37B
 Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.07



Site name: ALSTONFIELD

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

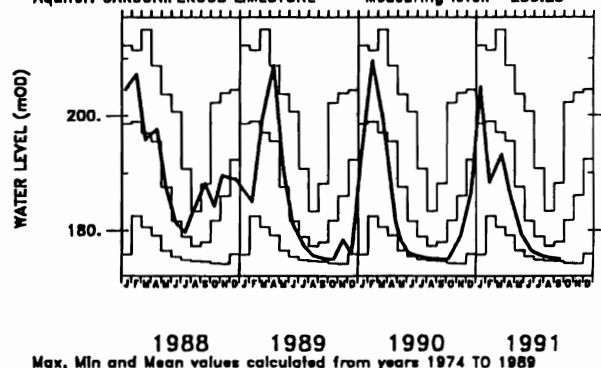


TABLE 5 A COMPARISON OF SEPTEMBER GROUNDWATER LEVELS : 1991, 1976 AND 1973

Site	Aquifer	Records commence	Average September Level	September 1976		September 1976		September and October 1991		No of years September levels <1991	Lowest pre-199 level (any month)
				Day	Level	Day	Level	Day	Level		
Dalton Holme	C & UGS	1889	15.67	29/09	15.90	25/09	11.87	29/09	12.83	4	10.34
Little Brocklesby	C & UGS	1926	11.61	18/09	10.24	24/09	4.56	29/09	5.85	2	4.56
Washpit Farm	C & UGS	1950	43.98	1/09	41.40	1/09	41.70	1/10	41.01	0	41.24
The Holt	C & UGS	1964	87.45	30/09	84.36	2/09	84.59	15/09	85.26	3	83.90
Fairfields	C & UGS	1974	23.04	-	-	24/09	22.56	10/09	22.18	1	22.15
Redlands Farm	C & UGS	1964	40.79	1/09	36.50	1/09	36.00	16/09	33.90	0	34.04
Rockley	C & UGS	1933	131.06	30/09	130.79	26/09	dry	15/09	130.24	>10	dry (below 128.78)
Little Bucket Farm	C & UGS	1971	65.56	10/09	59.73	30/09	57.64	25/09	62.30	5	56.77
Compton House	C & UGS	1894	33.11	20/09	30.10	30/09	27.72	2/09	34.17	>10	27.64
West Dean	C & UGS	1940	1.46	23/09	1.29	24/09	1.37	27/09	1.47	>10	1.01
Lime Kiln Way	C & UGS	1969	125.09	28/09	124.75	15/09	124.12	10/09	124.48	1	124.09
Ashton Farm	C & UGS	1974	65.28	-	-	24/09	63.23	1/10	65.40	>10	63.10
West Woodyates	C & UGS	1942	72.84	30/09	71.09	1/09	67.67	30/09	73.50	>10	67.62
New Red Lion	LLst	1964	12.03	30/09	10.85	28/09	3.68	09/09	7.42	2	3.29
Ampney Crucis	Mid Jur	1958	100.28	30/09	99.72	26/09	97.87	16/09	99.81	8	97.38
Dunmurry (NI)	PTS	1985	87.19	-	-	-	-	26/09	27.51	1	27.47
Llanfair DC	PTS	1972	79.61	1/09	79.37	1/09	78.85	16/09	79.24	2	78.85
Morris Dancers	PTS	1969	32.58	26/09	32.23	21/09	31.85	10/09	32.05	2	30.87
Weeford Flats	PTS	1966	90.13	28/09	90.13	29/09	88.61	19/09	dry	1	88.61 (dry)
Bussels 7A	PTS	1972	23.49	26/09	23.25	28/09	23.09	12/09	23.39	7	22.90
Rusheyford NE	MgLst	1967	75.97	1/09	64.89	28/09	66.13	04/09	75.21	>10	64.77
Peggy Ellerton	MgLst	1968	34.28	21/09	32.29	27/09	31.10	05/09	33.08	4	31.10
Alstonfield	CLst	1974	178.02	-	-	01/09	174.56	20/09	175.11	5	174.22

Groundwater levels are in metres above Ordnance Datum

C & UGS Chalk and Upper Greensand
LLst Lincolnshire Limestone
PTS Permo-Triassic sandstones

Mid Jur
MgLst
CLst Middle Jurassic limestones
Magnesian Limestone
Carboniferous Limestone

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS

